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Ontario Geological Survey
Open File Report 6101

Toward a New Metamorphic Framework for Gold Exploration in the Timmins Area, Central Abitibi Greenstone Belt

2002

103-02306/

Ontario

ONTARIO GEOLOGICAL SURVEY

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Toward a New Metamorphic Framework for Gold Exploration in the Timmins Area, Central Abitibi Greenstone Belt

by

P.H. Thompson

2002

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Thompson, P.H. 2002. Toward a new metamorphic framework for gold exploration in the Timmins area, central Abitibi greenstone belt; Ontario Geological Survey, Open File Report 6101, 51p.

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Abstract

This report summarizes the results of a pilot study that makes the first step toward a new metamorphic framework for the Timmins camp. The report examines the constraints that metamorphic data and concepts impose on the timing, duration, and nature of deformation, magmatism, alteration and gold mineralization. The data and interpretations are based on reconnaissance petrography of 341 thin sections from locations spread across the townships of McKeown (1), Keefer (10), Denton (90), Thorneloe (9), Carscallen (40), Bristol (57), Ogden (34), Deloro (4), Tisdale (21), and Whitney (75). This study is the first to use this material to document variations in metamorphic grade and to apply the new information to the problem of the origin and location of gold deposits in the region. The fresh perspective advances knowledge of known mineralized zones and will help to define new exploration targets.

Metamorphic evidence indicates four thermal events with potential for mobilization and deposition of gold have occurred in the project area. These are: 1) pre-metamorphic synvolcanic magmatism; 2) Archean regional metamorphism; 3) syn- to post-orogenic Archean contact metamorphism; 4) Proterozoic regional metamorphism. There is petrographic evidence of pre-metamorphic synvolcanic alteration of the type that can be associated with porphyry-related gold mineralization and of syn- to post-metamorphic carbonate-chlorite alteration characteristic of shear zone-hosted gold mineralization. Previously unmapped zones of transition and higher grade metamorphic mineral assemblages (medium to upper greenschist and, locally, amphibolite facies) are bounded by an isograd that corresponds approximately to the biotite isograd, a feature recognized as a potential exploration tool in the Eastern Goldfields area of Western Australia. Three isolated occurrences of these rocks are close to gold mines. The anomalously high-grade zones represent irregularities in the thermal regime that have the potential to influence the geometry and volume of fluid flow and to focus mineralizing fluids. The zones may be related to buried plutons that could be themselves sources of fluids and heat. Alternatively, the thermal anomalies result from heat transferred along structural conduits by conduction or by fluid flow.

Pressures and temperatures of metamorphism during the Archean thermal events were within the range of conditions to be conducive to gold deposition (250-450°C, 1-3 kbars). Analysis using a depth-time diagram constructed for the project area indicates the greenstone belt was subjected to these conditions for tens of millions of years. During this period, shorter duration events such as granitoid intrusions or formation of deformation zones may have been necessary to produce a gold deposit.

Future work should:

- Integrate metamorphic data and concepts with other data sets in order to define multi-parameter exploration targets. For example, use gravity and aeromagnetic data to test the possibility that the transition/higher grade zones are related to hidden plutons.
- Test the hypothesis that some gold mineralization is related to the biotite isograd marking the onset of transition and higher grade metamorphism by more sampling and petrography in Ogden and Tisdale townships.
- Investigate further the degree to which Timiskaming metasedimentary rocks and the alkalic intrusive suite have been metamorphosed in order to better constrain the timing and duration of metamorphism.
- Characterize petrographically known mineralization and alteration in order to enhance interpretation of current and future metamorphic data.
- Apply the approach and methods used in this study to key areas elsewhere in the Abitibi greenstone belt.
- Design an exploration model that incorporates deposit types that can be related to the four thermal events evident from metamorphic data.

Toward a New Metamorphic Framework for Gold Exploration in the Timmins Area, Central Abitibi Greenstone Belt

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Ontario Geological Survey
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Introduction

This report summarizes the results of a pilot study to develop a metamorphic data base for the Timmins gold camp. The study was jointly supported by Placer Dome Inc. and the Ontario Geological Survey (OGS) through a Collaborative Project Agreement with Peter H. Thompson Consulting Ltd. This pilot study is the first step toward a new isograd map and more comprehensive metamorphic data base for the Timmins gold camp. Metamorphic data and concepts derived from metamorphic petrology contribute to the development of new gold exploration models in three key areas. First, metamorphic mineral assemblages and textures constrain the timing, duration and depth of deformation and plutonism, two important factors in the formation of many gold deposits. Second, definition of the distribution and intensity of "background" metamorphic grade helps to define the limits and nature of alteration related to pre-metamorphic, synvolcanic deposits and of carbonate alteration associated with syn- and post-metamorphic, shear zone-hosted gold mineralization. Third, changes in crustal thermal regimes as recorded by isograd patterns and mineral assemblages strongly influence the volume, direction, and duration of mineralizing fluid flow. The data and interpretations presented here are based on reconnaissance petrography of 341 thin sections from locations spread across the townships of McKeown (1), Keefer (10), Denton (90), Thorneloe (9), Carscallen (40), Bristol (57), Ogden (34), Deloro (4), Tisdale (21), and Whitney (75). The sections were obtained from the OGS archival collection and from staff geologists L. Hall and C. Vaillancourt. This study is the first to use these thin sections to document variations in metamorphic grade and to apply the new data and metamorphic concepts to the origin of gold deposits in the region.

Metamorphism in the western segment of the Abitibi greenstone belt is not as well documented or as well understood as stratigraphy, structure, volcano-sedimentary processes, geochemistry, and ore deposits. Completed 24 years ago, the only regional petrographic study (Jolly 1978) resulted in a metamorphic map at 1:3 600 000 scale. A metamorphic map of Ontario (Easton, in press) will be published at 1:1 000 000 scale. Both these maps are important contributions, but the scale is not appropriate for the work proposed here. More detailed geological compilation maps (1:100 000 scale) recently released for the Ontario portion of the Abitibi greenstone belt (e.g., Ayer and Trowell 1998) do not include isograds. In the western part of the Abitibi greenstone belt, detailed metamorphic studies are limited to areas southwest (Powell et al. 1993) and south (Jolly 1974) of Kirkland Lake. This pilot project begins to address these shortcomings.

Integration of the metamorphic data and concepts with other data sets is a key step in the application of metamorphic studies to mineral exploration programs. Time constraints on this project limit integration to a preliminary assessment of the implications with respect to deformation, plutonism, and alteration/mineralization in eight townships. Extrapolation of these observations from township to township is constrained by significant variations in data density. This report documents parts of a new metamorphic framework and examines briefly the relationships between metamorphism and deformation, magmatism, alteration and gold mineralization. The fresh perspective advances knowledge of known mineralized zones and points to several areas where the viability of metamorphic features as exploration tools can be tested.

Terminology

Metamorphism refers to the changes in mineralogy and texture that occur when a sedimentary, igneous or metamorphic rock is subjected to physical conditions (e.g., temperature, pressure, fluid composition) that are different from those at the time of its formation.

Metamorphic grade is a relative measure of the intensity or completeness of metamorphism. The changes occur in minerals making up the rock (mineral assemblages), in textures (grain size and shape, relationships between mineral grains), and in structures (planar and linear aggregates of minerals such as cleavage, foliations, folds, veins, compositional layering that are pervasive throughout the rock). Variations in grade are evident at the scale of the map, outcrop or thin section.

An **isograd** is a line or surface of constant metamorphic grade. It is commonly mapped as the first appearance of a mineral or mineral assemblage in rocks of similar composition. Although fluid composition variations may complicate the picture, isograds in different compositions are typically concordant.

In general, and neglecting the addition or subtraction of small amounts of water or carbon dioxide, **rock composition** does not change during metamorphism. Rocks of different composition respond differently to increasing metamorphic grade. This means that specific stratigraphic markers or pre-metamorphic hydrothermal alteration zones can be mapped from the lowest to highest grades in metamorphic terranes.

Regional metamorphism occurs across thousands of square kilometres and lasts tens of millions of years. It is caused by the heating and deformation of rocks during mountain-building processes related to subduction of oceanic crust and continental collision.

Contact metamorphism is the result of heating near an igneous intrusion. Duration is in the range of thousands to hundreds of thousands of years. Contact metamorphic zones are centimetres to kilometres (~1-3 km) thick.

Alteration (metasomatism) is a kind of metamorphism that involves the movement of non-volatile elements in and out of a rock. Typically structurally controlled and of limited distribution (centimetres to hundreds of metres), alteration can have a time frame similar to that for contact metamorphism.

Temperature increasing with depth in the crust or with proximity to an igneous body is the parameter that causes the most obvious changes observed in metamorphic rocks. **Pressure** on solid components of rocks increases with depth in the crust at a rate dependent on the average density of overlying rocks (crustal average - 2.80 g/cm^3, ~ 0.034 GPa/km, ~ 0.34 kbar/km). For most natural systems, pressure on the intergranular fluid phase (P_{fluid}) during regional and contact metamorphism is assumed to equal P_{solid} .

Depth-time diagrams (Thompson 1989a, 1989b, 1999) illustrate the evolution of mineralized rocks with respect to changes in temperature and pressure during deposition, deformation, mineralization, metamorphism and exhumation (uplift and erosion) of greenstone belts. The **"gold deposition zone"** (Thompson 1999, 2000) is derived from the suggestion by Loucks and Mavrogenes (1999) (they cite Hodgson et al. 1993 and Phillips et al. 1997) that 90% of the gold mined from metamorphic terranes around the world was deposited between temperatures of 250 and 450°C and pressures of 1 and 3 kilobars.

Acknowledgements

Initiated by R. Keele (Placer Dome CLA Limited) following a Yellowknife EXTECH III Project field trip, the study benefited greatly from his interest and advice. J. Ayer's (Ontario Geological Survey (OGS)) support and enthusiasm are much appreciated. He and his colleagues, L. Hall and C. Vaillancourt, provided the thin sections and sample locations, the core of the project.

Methodology

The proposed project area covers all or parts of nine townships east, west, and southwest of Timmins (Figure 1): Keefer, Denton, Thorneloe, Carscallen, Bristol, Ogden, Deloro, and Tisdale. There are only 4 thin sections available for Deloro Township. One sample falls in McKeown Township. The uneven distribution of thin sections results from sampling priorities during bedrock mapping by the OGS and the absence of outcrop across wide zones in the project area. Of the 341 OGS thin sections examined for this study, 207 had not been looked at before and, with respect to applied metamorphic petrology, the full potential of the rest had not been realized. UTM coordinates were measured on maps or obtained from other OGS sources and, where necessary, converted to the NAD 1983 datum.

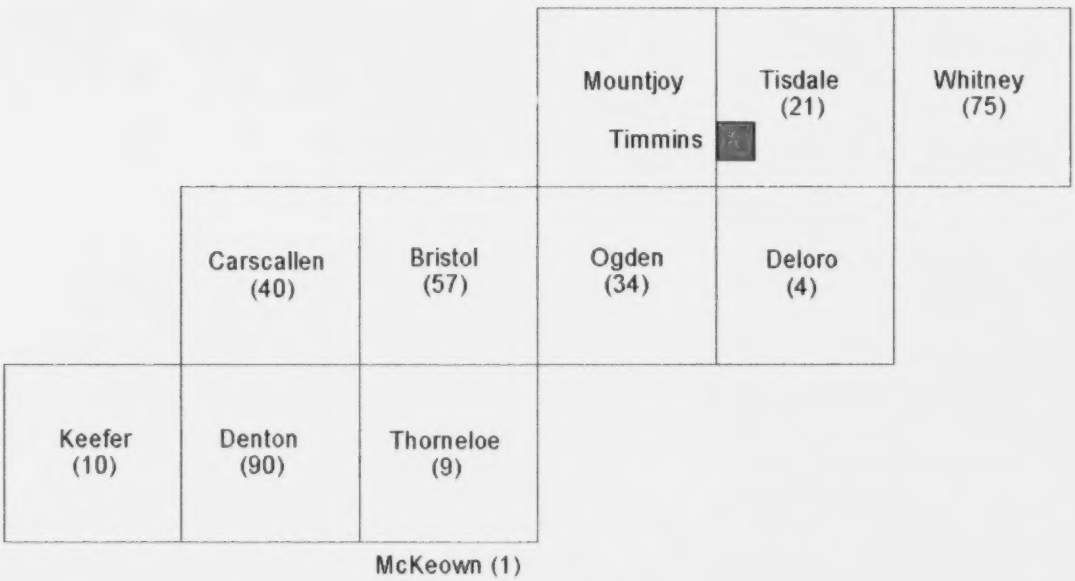

Figure 1. Distribution by township of the 341 Ontario Geological Survey thin sections examined for this study.

PETROGRAPHY

Reconnaissance petrography of 341 thin sections is the basis for: a) determination of eight rock associations or generalized rock types; b) identification of the mineral assemblages produced by the predominant metamorphic event; c) approximate modal analyses; d) comments on vein mineralogy and alteration (where present); e) some structural observations. Table 2 (Appendix 1) documents these observations, along with map reference numbers, sample numbers, location, and metamorphic grade. The metamorphic map (Figure 2, back pocket) illustrates variations in metamorphic grade and in rock association as determined by petrography. The map is derived from Table 3 (Appendix 2) which presents sample location, grade and rock association data only. Discrepancies between the degree of uncertainty for grade and rock association between Tables 2 and 3 are judgement calls by the author.

ROCK ASSOCIATIONS AND METAMORPHIC ZONES

Evaluation of the grade of metamorphism in eight rock associations (Table 1) ensures that some measure of grade can be estimated from most, if not all, thin sections. Of the eight lithologic packages distinguished, mafic meta-igneous rocks and metamorphosed quartzofeldspathic rocks are most widely distributed. Rock types 7 and 8 were grouped together in an earlier report (Thompson 2002a, 2002b). The rock type identified from thin section does not always correspond to rock units on the geological compilation map.

Table 1. Characteristic minerals or mineral assemblages in low grade, transition and higher grade metamorphic zones. See legend for Table 2 (Appendix 1) for mineral name abbreviations.

Rock Association	Characteristic Minerals/Assemblages		
	Low Grade Zone	Transition Zone	Higher Grade Zone
1) Mafic meta-igneous rocks (greenstone, amphibolite)	cht-epg-act -plg(sodic)	hn-act-epg/cht	hn-plg(calcic)
2) Meta-quartzofeldspathic rocks (metamorphosed volcaniclastite/epiclastite, qtz-fp porphyry, metasandstone/psammite)	cht-wm(K, Na) cht-Kf cht-wm-cb		bt, epg
3) Ultramafic meta-igneous rocks	tc-se-cht-cb tc-cht-cb, se-cb	am-cht-cb	am(cum)
4) Meta-aluminous rocks (metasedimentary rocks, meta-alteration)	cht-wm	ctd-cht	bt
5) Chemical metasedimentary rocks (e.g., meta-iron formation)	cht-cb-qtz		am, grt
6) Metagranitoids (metagranite to metatonalite)	cht-wm-epg replace bt/am		bt
7) Chlorite-carbonate schist/phyllite	cht-wm-cb	am-cht-cb	am-qtz
8) Altered rocks (some metamorphosed)	cht, se, wm, cb		bt, am

The relative nature of the terms low, transitional, and higher grade used in this report is appropriate given the irregular distribution and density of data. Although low, transition, and higher grade assemblages in one rock "type" do not necessarily correspond to those defined in another, the general concordance indicates that the extrapolations made here are valid. In most cases, a line can be drawn that separates low grade assemblages from the transition zone and higher grade zone assemblages. This line corresponds approximately to the appearance of biotite (biotite isograd) in quartzofeldspathic rocks. Given that observations are limited to single thin sections, there is a degree of uncertainty about the rock type and/or metamorphic grade for some samples (*see* Tables 2 and 3, Figure 2). Uncertainty about rock association is indicated by a question mark in Tables 2 and 3, and by a specific symbol on the metamorphic map (*see* Figure 2). Uncertainty about metamorphic grade is indicated by the letter "U" or question marks in the tables and by white symbols on the map. The distribution of point data on the metamorphic map and the occurrences of samples of uncertain grade or lithology are a measure of the degree of control on the metamorphic zone boundary.

Correlation of metamorphic grade in different rock compositions is reasonably good. It is possible, therefore, to evaluate metamorphic grade more accurately in areas where one or the other of the predominant rock associations are poorly represented. Although metamorphic zonation is less well-defined in the "less reactive" mineral assemblages that make up quartzofeldspathic rocks, at low grade, the appearance of biotite is a mapable isograd. In the Eastern Goldfields area of Western Australia (Mikucki and Mikucki 1999), this feature is considered to be a useful guide to gold exploration.

Metamorphic Grade at Township Scale

This section of the report summarizes the metamorphic data and its relations to greenstone belt lithologies, structures, granitoid rocks, and several gold occurrences mapped by previous workers. In order to maintain continuity of the geological framework from one township to the next, the recent 1:100 000 scale geological compilation (Ayer and Trowell 1998) provides a lithologic framework for comparison of the townships in the study area. To simplify numbering of sample locations, a single continuous set of map numbers has been assigned to the sample numbers (*see* Tables 2, 3; Figure 2). The interpretive aspects of this and subsequent sections of the report are limited by the reconnaissance nature of the study. In many cases, more data are required to verify the implications of the new metamorphic constraints.

KEEFER TOWNSHIP

The thin sections obtained for Keefer Township (Choudhry 1989) occur in a westward narrowing segment of greenstone belt that is bounded to the north and south by granitoid rocks (*see* Figure 2, Table 2). The metamorphic assemblages are somewhat ambiguous. Low grade samples adjacent to the granitoid (map numbers 1, 4, 8) imply that the biotite zone (higher grade) in quartzofeldspathic rocks is quite narrow or does not exist everywhere along the contact. That is, if the higher grade is a contact metamorphic affect, the granitoid was not very hot at the time of intrusion. The sparse data are consistent with a transition/ higher grade zone that is at a high angle to the granitoid contact. Furthermore, the higher grade zone, as it is currently interpolated, appears to be folded. The occurrence of low grade samples adjacent to the plutonic rocks and the inferred distribution of higher grade rocks are consistent with the granitoids being either older or younger than the metamorphism. The relatively high grade zone in the middle of the greenstone belt may represent a buried syn-metamorphic granitoid or a structural feature that enhanced the flow of heat relative to rocks to the west and east.

DENTON TOWNSHIP

Sample density is higher in Denton Township (*see* Figure 2, Table 2) where samples collected by Choudhry (1989) are combined with those collected by Hall (2001). There is evidence of a narrow, relatively high grade zone parallel to a segment of the northern granitoid (Carlton pluton). At the eastern end of the pluton, however, low grade rocks interpreted to be metamorphosed supracrustal rocks occur in the area previously mapped as granitoid. If the location of the contact is correct, two possibilities merit consideration. First, the quartzofeldspathic rocks were high grade supracrustal material to begin with, but were retrograded during a later deformation/alteration event. Alternatively, the samples are retrograded and deformed granitoid.

In the eastern half of the township, the distribution of the higher grade zone indicates that this part of the southern granitoid (Kenogamissi batholith) was hot enough to generate a contact aureole. Furthermore, the heat source extends well to the north of the granitoid contact, implying that the contact dips moderately to the north. This interpretation is complicated somewhat by evidence farther south that the granitoid has been deformed within the stability field of biotite and contains supracrustal rocks that have been metamorphosed at somewhat lower grade than similar rocks in the contact aureole.

The occurrence of a low grade metamorphosed mafic igneous rock (map number 58) at the same station as amphibolites, characteristic of the higher grade zone, can be explained if the sample is from a younger diabase dike. That is, the dike is younger than the main metamorphism, but it has been subjected to a subsequent Proterozoic metamorphism. Easton (2000) documents other examples of Proterozoic metamorphism 65 km farther east. This thermal event likely retrograded, to a variable degree, wide zones of Archean rocks in the greenstone belt (see below, "Metamorphism and Mineralization").

Samples included in the rock association labelled chlorite-carbonate schist/phyllites (*see* Table 1) tend to occur in the vicinity of major east-striking faults that are part of the Porcupine-Destor fault zone (*see* Figure 2). The concentration of these rocks in the southwest corner of the township suggests that the geological compilation map (Ayer and Trowell 1998) does not tell the whole story. Furthermore, the higher grade foliated amphibolites (first pointed out to me by L. Hall) at the station where several samples (map numbers 55 to 60) were obtained imply high strain occurred under high grade metamorphic conditions (see below, "Metamorphism and Deformation").

THORNELOE TOWNSHIP

Once again, limited metamorphic data (*see* Figure 2, Table 2; samples collected by Choudhry 1989) point to the presence of a granitoid pluton or a northern extension of the southern granitoid body that is not evident on the surface. The transition zone rocks along the northern edge of the township indicate the small granitoid pluton immediately to the north is larger at depth.

CARSCALLEN TOWNSHIP

Forty thin sections (5 from C. Vaillancourt, 35 from L. Hall) are widely scattered across Carscallen Township (*see* Figure 2, Table 2). The higher grade zone appears to be discordant to the north contact of the Carlton pluton. This pluton corresponds to the "northern granitoid" that occurs in the northern part of Denton Township. The occurrence of a cluster of low grade rocks adjacent to the granitoid intrusion in the northeast corner of Carscallen Township, is interpreted as evidence that this pluton pre-dates the metamorphic event.

BRISTOL TOWNSHIP

Fifty-seven thin sections obtained from C. Vaillancourt (Vaillancourt 2000) outline two areas of higher grade in Bristol Township (*see* Figure 2, Table 2). In the southwest corner, sample 183 indicates that the zone of higher grade in Thorneloe Township to the south may extend north for 2 km. Once again, there is apparently no surface expression of a granitoid heat source. Immediately east of the zone, map number 179, is an alkali intrusion that may itself be metamorphosed. Crossite rims on clinopyroxene could be metamorphic or late magmatic features. Grain boundary relations suggest that the rock has been strained. In any case, this small pluton is more likely to be part of an alkalic igneous suite (Vaillancourt et al. 2001) than the felsic to intermediate intrusive suite indicated by Ayer and Trowell (1998). Nearby supracrustal rocks are all in the low grade zone and contact metamorphic effects are minor. It is possible that this small pluton was metamorphosed by the thermal event that produced the transition zone assemblages to the west and southwest.

Biotite-bearing rocks that define the northern zone of higher grade rocks could be a contact effect of an extension to the granitoid unit in the northwest corner of the township. However, biotite-free quartzofeldspathic rocks occur close to this body and on both sides of a similar elongate pluton 1 km to the west (*see* Figure 2, Carscallen Township). Vaillancourt mapped the mafic intrusive as metamorphosed. It is more likely that a different pluton produced the higher grade zone. Absence of an isograd around three transition zone epidote-rich meta-epiclastites (152, 170, 171), one of which contains actinolite, reflects absence of biotite. The concentration of carbonate-chlorite schist/phyllites rocks south of the northern higher grade zone (*see* Figure 2) corresponds approximately with the gold-bearing Allerston shear zone as it is shown on Vaillancourt's (2000) map. The relatively large amount of tourmaline in sample 187 is a combination of detrital grains and metamorphic porphyroblasts. Such high boron content may indicate significant exhalative activity during deposition of the surrounding meta-epiclastic rocks.

OGDEN TOWNSHIP

Ogden Township is almost entirely within the low grade zone (*see* Figure 2, Table 2; samples from C. Vaillancourt). It is interesting that two of the three transition zone samples appear to be associated with gold mines. A sample (map number 223) was collected in the vicinity of the De Santis Mine and a sample (map number 224) near the Naybob Mine (*see* Figure 2). The third transition zone assemblage (map number 233) is located close to another transition zone assemblage in Deloro Township (map number 234) in an area where Ayer and Trowell (1998) used aeromagnetic interpretation to compile the geology of the area.

Two other samples from Deloro Township are included here. The low grade metamorphosed diabase (map number 226) is another example of a diabase that post-dates the main metamorphic event, but is itself metamorphosed. The sample likely comes from a Biscotasing dike (2167 Ma) inferred from aeromagnetic data on the geological compilation map.

Biotite in the biotite granite pluton (map number 221) is partially replaced by chlorite and, possibly, prehnite. Epidote group minerals that overgrow biotite and white mica in plagioclase are clearly secondary. Although there is no evidence in thin section of deformation, the granitoid is interpreted to be affected by low grade metamorphism.

TISDALE TOWNSHIP

The twenty-one thin sections examined are concentrated in the southern third of Tisdale Township (*see* Figure 2, Table 2; collected by Piroshco and Kettles 1991). Two of the samples (map numbers 265, 266) included in the larger of the two possible transition zones contain stilpnomelane. The stability field of this mineral extends to lower grade than that of biotite. However, the presence of amphibole-rich, chlorite-bearing, metamorphosed ultramafic rock (map number 247) is consistent with transition grade rocks in this area. The latter sample was collected in the vicinity of the Dome Mine, which supports the possible correlation between transition grade rocks and gold mineralization (see above, "Ogden Township"). The long dimension of this transition zone is parallel to a line that joins the Dome, Paymaster, and Fuller mines several hundred metres to the southwest. Unfortunately, OGS thin sections are unavailable southwest of the Dome Mine.

There is some uncertainty about the identification of biotite (possibly stilpnomelane) in the transition zone rocks that were collected closer to Timmins (map number 261), due to the very fine grain size of the rocks. Further sampling and petrography in Tisdale Township is a priority in order to evaluate the possible link between gold mineralization and the high-grade side of the isograd that marks the change from low to transition metamorphic grade.

WHITNEY TOWNSHIP

A large number of samples (75) were collected in Whitney Township but Piroschco and Kettles (1991) skewed the distribution toward the southwest corner (*see* Figure 2, Table 2). Low grade metamorphic rocks are predominant. Two samples define one area of transition/higher grade in quartzofeldspathic rocks. In this case, trace amounts of biotite in one sample (map number 303) are consistent with the presence of amphibole in nearby meta-epiclastite (map number 338). The latter rock is sufficiently mafic, however, that the trace amount of biotite it contains cannot be directly correlated with that in map number 303. For the same reason, trace amounts of the mineral in a meta-ultramafic rock (340) near the west border of the township are not included in a transition/higher grade zone. Other examples of higher metamorphic grade are defined by biotite in foliated potassium feldspar meta-porphyry (297), quartz-feldspar meta-porphyry (336) and foliated meta-epiclastite (317). In the northeast corner of the township (*see* Figure 2), map number 313 is characterized as a transition grade meta-ultramafic rock even though the presence of amphibole is only reasonably certain (*see* Table 2). The absence of an isograd is an indication of this uncertainty. Some chlorite in another meta-epiclastite (305) may be retrograde after biotite. Without confirmation by microprobe or X-ray diffraction techniques, there is uncertainty about the presence of biotite at three other localities (map numbers 261, 266, 282). Map number 282 is of particular interest because, according to the geological compilation map (*see* Figure 2), this sample occurs in the same deformation zone as does high metamorphic grade locality 297.

According to sample locations on preliminary map P.3172 (*see* Open File Report 5768, Piroschco and Kettles 1991) rocks at map numbers 310, 314 and 315 (*see* Figure 2) are "younger metamorphic rocks (Timiskaming-type)". These localities are not interpreted to be underlain by Timiskaming rocks on the Ayer and Trowell (1998) map. Mineral assemblages and textures in these samples are consistent with the Timiskaming sequence being metamorphosed together with older rock units adjacent to the north (map numbers 311 to 313), if the Piroschco and Kettles (1991) stratigraphy is correct. Powell et al. (1993) summarized evidence for this sequence of events elsewhere in the Abitibi greenstone belt.

Metamorphism and the Geological Setting of Mineralization

METAMORPHISM AND DEFORMATION

The links between geological structures and the formation of gold deposits are widely recognized. Why some structures are more prospective than others is explained in part by the timing and duration of deformation with respect to heating and cooling of the rocks which are key factors for fluid production and for mobilization and precipitation of gold. Metamorphic data and concepts help to establish these relationships in time and in space.

Formation of metamorphic mineral assemblages and textures across the project area correspond with the deformational events that produced the folds, foliations and high strain zones. The mineral assemblages in a range of rock types indicate that much of the deformation occurred when rocks, now at the Earth's surface, were buried to depths greater than 7 to 10 km (pressures of 2 to 3 kbars) and heated to temperatures that ranged from 350 to 450°C on a regional scale. Higher temperatures were attained in contact metamorphic aureoles immediately adjacent to intrusive granitoid bodies. The widespread evidence of rotation and syn-metamorphic flattening and shearing of the greenstone belt is consistent with shortening and thickening of the crust to such an extent that uplift and erosion occurred. As the crust returned to normal thickness, metamorphosed sedimentary, volcanic and plutonic rocks and gold deposits therein were exhumed to the Earth's surface. The author has argued elsewhere (Thompson 1989a, 1989b, 2001) that the lithospheric thinning and consequent production of anomalously high geothermal gradients that accompanied the formation of the volcano-sedimentary sequence is an essential precursor to the metamorphic and deformational evolution of a greenstone belt.

The coincidence of carbonate-chlorite schist/phyllite (identified in thin sections) with the gold-bearing Allerston shear zone, as shown on Vaillancourt's (2000) map of Bristol Township, indicates that other occurrences of such rocks identified by this study (*see* Figure 2) may have some gold potential. Distinguishing between highly prospective carbonate-chlorite-rich deformation zones and ordinary metamorphosed marly sedimentary or volcaniclastic rocks is not always possible on the basis of thin sections alone. The correspondence with the Allerston shear zone, however, is sufficient basis for further work in and around the new localities (see Figure 2).

Mineralizing fluids, channelled and trapped by key structures in the Timmins gold camp, may have produced localized hot spots or ridges that can be found by mapping the distribution of transition and higher grade mineral assemblages relative to these structures. This pilot petrographic study sets the scene for further work on the relationships between mineralization, fluid flow channels and major structures.

METAMORPHISM AND MAGMATISM

The granitoid rocks in metamorphic terranes are commonly assumed to be the source of the heat that caused the mineralogical and textural changes in metamorphosed igneous and sedimentary rocks. Metamorphic evidence from the project area (*see* Figure 2) indicates that granitoid units are both older and younger than metamorphism. In the northeast corner of Carscallen Township the absence of transition/higher grade rocks is consistent with a pre-metamorphic age for granitoid rocks mapped by Ayer and Trowell (1998). On the west side of the township, however, the apparent discordance between metamorphic zonation and the east-striking granitoid contact (Carlton pluton) can be attributed to a

younger, cross-cutting intrusion (Carlton pluton). In Keefer Township (*see* Figure 2), where granitoid rocks are predominant and the metamorphic grade is expected to be high, the narrow zone of greenstone belt is unexpectedly low grade. More data is required to determine if the plutonic bodies are sheet-like bodies that are too thin to heat the adjacent rocks to high grade or if they are, in part, older than the low grade metamorphic event. Granitoid rocks are probably not the heat source for the extensive low grade metamorphism of supracrustal rocks in Tisdale and Whitney townships. However, localized zones of transition and higher metamorphic grade rocks across the study area may indicate the presence of small buried plutons. South of Kirkland Lake, Jolly (1974) mapped contact aureoles around small intrusive stocks that have been imposed on aureoles related to older mafic intrusions. Jolly (1974) argued that the Round Lake batholith is older than the main metamorphism in the region. The latter conclusion is consistent with the lack of an amphibolite zone around the batholith on a metamorphic map compiled by Powell et al. (1993). However, Chown et al. (2002) indicate that the early tonalitic phases have narrow metamorphic aureoles attenuated by shearing along the contacts of the batholith, whereas late granodiorite phases (ca. 2697 Ma) that intrude the tonalite have unattenuated aureoles within the surrounding supracrustal rocks. That is, metamorphic evidence in the project area for granitoids that are older and younger than the main metamorphic event is supported by more detailed work elsewhere in the Abitibi greenstone belt.

Petrographic evidence supports inclusion of the small pluton in the southwest part of Bristol Township (*see* Figure 2) in the alkalic suite (Vaillancourt et al. 2001) rather than the felsic to intermediate suite as indicated by Ayer and Trowell (1998). If further work confirms that crossite rims, observed on clinopyroxene in a syenitic rock (*see* Figure 2, map number 179) from Bristol Township, are metamorphic, then these mineral assemblages will provide new constraints on the physical conditions of metamorphism and on the age of metamorphism relative to alkalic magmatism in the region.

On the new metamorphic map (*see* Figure 2), spatial relationships between transition/higher grade rocks and some granitoid contacts are consistent with the plutons being the principal source of heat for metamorphism. Elsewhere, discordant metamorphic zones indicate that the granitoids are either too old or too young to be a significant source of heat. These spatial relations constrain the relative age of metamorphism and plutonism. Furthermore, in both cases, the metamorphic pattern is a guide to the thermal regime and to the geometry of potentially mineralizing fluid flow when metamorphism occurred. This information assists in the selection of the mineral deposit type or types that will be incorporated into the gold exploration program and in the definition of potential target areas.

Metamorphism and Alteration

Alteration is a key factor in determining the exploration potential of a region. Knowledge of the normal or "background" metamorphic mineral assemblages present in a range of rock types in a gold district highlights occurrences of the less common mineral assemblages that form in metamorphosed altered rocks and in syn- to post-metamorphic alteration zones. This study is based on thin sections made in support of geological mapping. These samples are not likely to be representative of altered rocks because the collectors were, in most cases, sampling relatively unaltered material in an attempt to characterize the geochemistry and general features of the major rocks units. There is evidence, however, of both pre- and syn- to post-metamorphic alteration.

Five townships include locations where alteration is interpreted to be present (*see* Figure 2, green ellipses). Chloritization, carbonatization, and/or K-metasomatism are inferred to have occurred (Thompson 2002a, 2002b). Samples included in the chlorite-carbonate schist/phyllite rock association are good candidates for the carbonate-chlorite alteration typically associated with shear zone-hosted gold

deposits. However, the extent to which these rocks have been altered cannot be determined from thin sections alone. These rocks could be deformed, metamorphosed calcareous mudstones. In many meta-quartzofeldspathic rocks of clastic origin, the texture of the carbonate suggests it is a primary phase (now recrystallized) that formed during deposition. In at least one case, the high proportion of white mica (assumed to be muscovite) likely reflects a pre-metamorphic potassic alteration of a felsic porphyry or volcaniclastic rock (map number 216, Ogden Township, *see* Figure 2). The striking chloritoid-carbonate-white mica-bearing rocks (278, 279) in Whitney Township are good candidates for pre-metamorphic alteration. Unusually high concentrations of chlorite are attributed to syn- to post-metamorphic alteration.

Metamorphism and Mineralization

The new metamorphic framework outlined in this report points to four periods during the evolution of the greenstone belt that have the potential to produce gold deposits. These are: 1) pre-metamorphic (synvolcanic) magmatism; 2) Archean regional metamorphism; 3) syn- to post-orogenic Archean contact metamorphism; 4) Proterozoic regional metamorphism. Figure 3 is a depth-time diagram constructed from the author's work in the Yellowknife greenstone belt in the Slave Province (Thompson 1999, 2000, 2001). Figure 3 illustrates the potential links between tectonic burial, deformation, metamorphism and exhumation for metamorphic types 1 and 2. Metamorphic Type 3 requires that a localized thermal anomaly of short duration be superimposed on this depth-time diagram. Type 4 implies an additional cycle of burial and exhumation.

PRE-METAMORPHIC (SYNVOLCANIC) MAGMATISM

The unusually high geothermal gradients, structures, abundant fluids, and igneous activity associated with formation of the volcano-sedimentary sequence together create a geological setting that is conducive to formation of porphyry-related or volcanogenic massive sulphide(VMS)-related gold deposits. Pre-metamorphic gold mineralization is metamorphosed and deformed along with the adjacent volcanic, high level plutonic and sedimentary rocks during subsequent orogenesis (*see* Figure 3). Metamorphosed alteration related to these deposits has a distinctive metamorphic mineralogy that can be identified by petrographic study. Altered rocks and suspected altered rocks identified by this study point to areas of interest.

ARCHEAN REGIONAL METAMORPHISM

The occurrence, across the project area, of rocks containing textural and mineralogical evidence of coeval metamorphism and deformation documents the second period of potential gold mineralization. That is, at the same time that structural conduits and traps were formed the rocks were buried to depths where temperatures are appropriate for gold deposition and large volumes of fluid were produced. Loucks and Mavrogenes (1999) concluded that ninety percent of the gold mined from metamorphic terranes around the world was deposited between 250 and 450°C and between 1 and 3 kbars (~3.5 to 10.5 km depth). During the evolution of the Abitibi greenstone belt in the Timmins area (Ayer et al. 2002), there is a period spanning tens of millions of years during which formation of syn- to post-metamorphic gold deposition is possible (*see* Figure 3). Petrographic studies of the type reported on here help to target the areas where the overlap of regional scale processes has maximized the potential for a deposit to form. Of particular interest is the biotite isograd as defined in quartzofeldspathic rocks (metamorphosed felsic volcanic and volcaniclastic rocks and metamorphosed epiclastites). It provides a method of subdividing the greenschist facies as defined on previous metamorphic compilation maps.

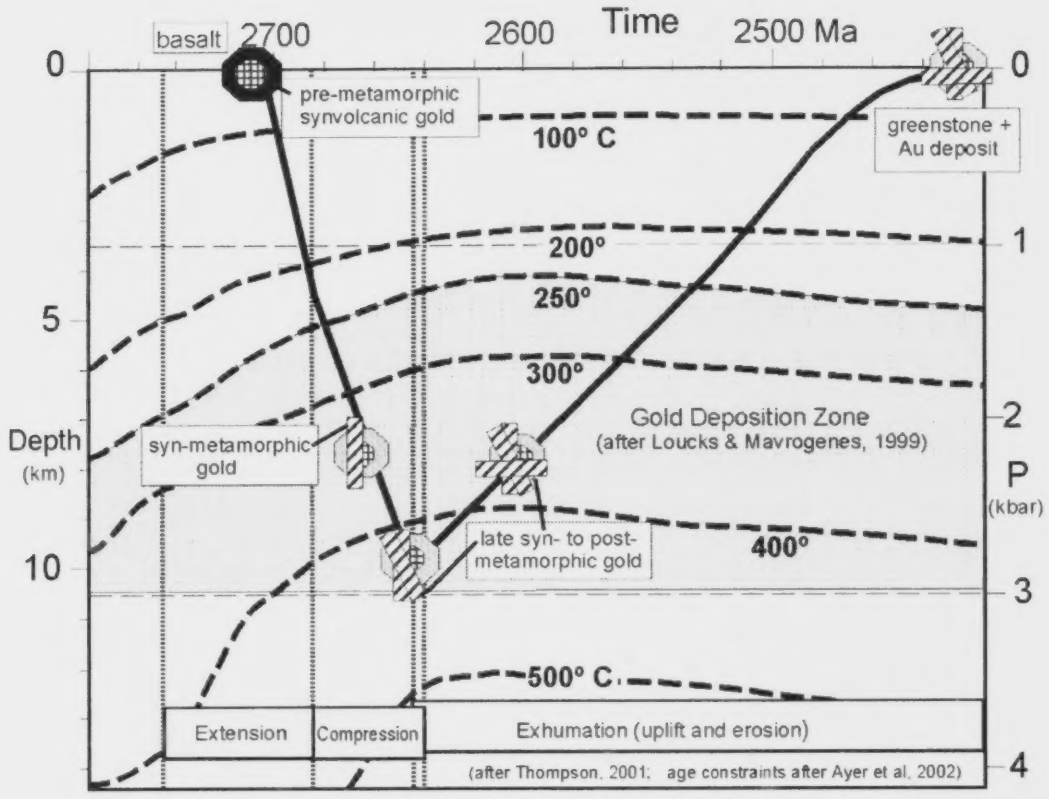

Figure 3. Depth-time diagram representing P-T evolution of a column of crust containing mineralized greenstone. Deposited within an extensional tectonic regime, basalt associated with synvolcanic, porphyry-related gold mineralization is buried during formation of the volcanic pile. The mineralized zone is deformed and metamorphosed as deformation associated with horizontal compression/crustal thickening transports the rocks to maximum temperatures and pressure in the upper greenschist facies (450°C/~3.5 kbars). The rock cools as exhumation (uplift and erosion) return the mineralized greenstone to the earth's surface. Three phases of deformation-zone-hosted gold mineralization are inferred to have occurred when the reference rock passed through the P-T conditions conducive to gold deposition.

SYN- TO POST-OROGENIC ARCHEAN CONTACT METAMORPHISM

Intrusive granitoid rocks disrupt and modify thermal and fluid flow regimes, by changing the geometry of isotherms in the crust and providing new localized sources of fluids as the magma crystallizes and as contact metamorphism drives fluid out of low grade, regionally metamorphosed country rocks. The anomalous occurrences of transition zone and higher grade zone rocks across the project area may indicate volumes of crust where granitoid plutons have modified the thermal and fluid flow regimes in ways that have increased the exploration potential for gold. The occurrence, in Ogden Township, of two high grade anomalies close to locations where gold has been mined merits further work on this aspect of the study. Also important in this regard is the recognized exploration potential of the biotite isograd in the Eastern Goldfields region of Western Australia (Mikucki and Mikucki 1999).

PROTEROZOIC METAMORPHISM

With only two samples of metamorphosed Proterozoic diabase dikes examined by this study, this phase of potential gold mineralization is the most speculative. Metamorphism of Proterozoic cover rocks by processes related to the Penokean Orogeny (Easton 2000) certainly affected the underlying Archean crust. The nearest sub-greenschist grade Huronian cover rocks are 60 km east of the project area and the Proterozoic tectonic activity along the Kapuskasing Structural Zone is 70 km to the west. It is conceivable that these events modified the thermal and fluid flow regimes in the Abitibi greenstone belt that remobilized gold. Of particular interest are major fault structures.

Conclusions and Recommendations

This report summarizes the results of a pilot study designed to investigate how new metamorphic data and the application of concepts derived from metamorphic petrology can contribute to mineral exploration in the Timmins area. Contributions include:

(1) Identification of four thermal events that had the potential to mobilize and deposit gold: a) pre-metamorphic (synvolcanic) magmatism; b) Archean regional metamorphism; c) syn- to post-orogenic Archean contact metamorphism; d) Proterozoic metamorphism.

(2) Petrographic observations at a number of localities will assist with future upgrading of bedrock mapping in the area.

(3) Spatial relations between the transition/higher grade zone and granitoid contacts indicate some plutons are too old or too young to be the heat source for metamorphism.

(4) Recognition, for the first time, of a biotite isograd that is defined in quartzofeldspathic rocks and has potential for use as a gold exploration tool in the Abitibi greenstone belt. Three of the occurrences of relatively high grade rocks discovered within extensive greenschist facies (low grade) zones, outlined on previous metamorphic compilation maps, are associated with gold mines.

(5) Relatively small, isolated occurrences of transition/higher grade rocks may reflect buried plutons at depth or locations where structures have channelled flow of heat and fluids. Both features are prospective.

(6) The coincidence of thin sections of carbonate-chlorite schist/phyllite with the gold-bearing Allerston shear zone as it is shown on Vaillancourt's (2000) map of Bristol Township indicates that other occurrences of such rocks identified by this study (*see* Figure 2) may have gold potential.

The updated metamorphic perspective on the Timmins camp provided by this pilot study has the potential to enhance exploration of known deposits and to help define new exploration targets. Recommended directions for further work are:

- Integrate metamorphic data and concepts with other data sets in order to define multi-parameter exploration targets. For example, use gravity and aeromagnetic data to test the possibilities that transition/higher grade zones are related to hidden plutons and/or structural focussing of the metamorphic fluid flow regime.

- Test the hypothesis that some gold mineralization is related to the biotite isograd, the lower limit of transition and higher grade metamorphism by further sampling and petrography in Tisdale and Ogden townships.

- Investigate further the degree to which Timiskaming metasedimentary rocks and the alkalic intrusive suite have been metamorphosed in order to better constrain the timing and duration of metamorphism.

- Characterize petrographically known mineralization and alteration in order to enhance interpretation of current and future metamorphic data.

- Apply the approach and methods used in this study to key areas elsewhere in the Abitibi greenstone belt.

- Design an exploration model that incorporates deposit types that can be related to the four thermal events evident from metamorphic data.

References

Ayer, J.A. and Trowell, N.F. 1998. Geological compilation of the Timmins area, Abitibi greenstone belt; Ontario Geological Survey, Preliminary Map P.3379, scale 1:100 000.

Ayer, J.A., Amelin, Y., Corfu, F., Kamo, S., Ketchum, J., Kwok, K. and Trowell, N. 2002. Evolution of the Abitibi greenstone belt based on U-Pb geochronology: autochthonous volcanic construction followed by plutonism, regional deformation, and sedimentation; Precambrian Research, v.115, p.63-95.

Choudhry, A.D. 1989. Geology of Keefer, Denton, and Thorneloe townships, District of Cochrane; Ontario Geological Survey, Open File Report 5699.

Chown, E.H., Harrup. R. and Moukhsil, A. 2002. The role of granitic intrusions in the evolution of the Abitibi belt, Canada; Precambrian Research, v.115, p.292-310.

Easton, R.M. 2000. Metamorphism of the Canadian Shield, Ontario, Canada. I. The Superior Province; Canadian Mineralogist, v.38, p.287-317.

Easton, R.M. (in press). Metamorphic map of Ontario; Ontario Geological Survey, scale 1:1 000 000.

Hall, L.A.F. 2001. Geology and mineral potential of Carscallen and Denton townships, Timmins West area; *in* Summary of Field Work and Other Activities 2001, Ontario Geological Survey, Open File Report 6070, p.5-1 to 5-11.

Hodgson, C.H., Love, D.A. and Hamilton, J.V. 1993. Giant mesothermal gold deposits; descriptive characteristics, genetic model, and exploration area selection criteria; *in* Whiting, B.H., Hodgson, C.H. and Mason, R. (eds), Giant ore deposits; Special Publication 2, Society of Economic Geologists, p.157-211.

Jolly, W.T. 1974. Regional metamorphic zonation as an aid in study of Archean terranes: Abitibi Region, Ontario; Canadian Mineralogist, v.12, p.499-508.

Jolly, W.T. 1978. Metamorphic history of the Archean Abitibi Belt; *in* Fraser, J.A. and Heywood, W.W. (eds), Metamorphism in the Canadian Shield, Geological Survey of Canada, Paper 78-10, p.63-78.

Loucks, R.R. and Mavrogenes, J.A. 1999. Gold solubility in supercritical hydrothermal brines measured in synthetic fluid inclusions; Science, v.284, p.2159-2163.

Mikucki, E. and Mikucki, J. 1999. Metamorphic petrography of the Eastern Goldfields, Western Australia: Coolgardie to Mt Belches Transect; unpublished report prepared for the Geological Survey of Western Australia, 12p.

Phillips, G.N., Zhou, T. and Powell, R. 1997. Metamorphic temperature variations among Witwatersrand goldfields: evidence from the pyrophyllite-chloritoid-chlorite mineral assemblage; South African Journal of Geology, v.100, p.393-404.

Powell, W.G., Carmichael, D.M. and Hodgson, C.J. 1993. Thermobarometry in a subgreenschist to greenschist transition in metabasites of the Abitibi greenstone belt, Superior Province, Canada; Journal of Metamorphic Geology, v.11, p.165-178.

Piroshco, D.W. and Kettles, K. 1991. Structural geology of Tisdale and Whitney townships, Abitibi greenstone belt, District of Cochrane, northeastern Ontario; Ontario Geological Survey, Open File Report 5768, 115p.

Thompson, P.H. 1989a. An empirical model for metamorphic evolution of the Archean Slave Province and adjacent Thelon Tectonic Zone, northwestern Canadian Shield; *in* Evolution of Metamorphic Belts, Geological Society Special Publication 43, p.245-263.

Thompson, P.H. 1989b. Moderate overthickening of thinned sialic crust and the origin of granitic magmatism and regional metamorphism in low-pressure/high-temperature terranes; Geology, v.17, p.520-523.

Thompson, P.H. 1999. Metamorphism and the origin of gold deposits in the Yellowknife Greenstone Belt, Interim Report 1 - the first step; unpublished report to Advisory Committee, EXTECH III, 20 p., (map, 1:77 519).

Thompson, P.H. 2000. Metamorphism and the origin of gold deposits in the Yellowknife Greenstone Belt, Phase 2 - new data and first applications 27th Yellowknife Geoscience Forum; (abstract, text and diagrams of talk) *in* EXTECH III, Yellowknife Greenstone Belt project update and 2-D digital database; Geological Survey of Canada, Open File D3962.

Thompson, P.H. 2001. Metamorphism and the origin of gold deposits in the Yellowknife Greenstone Belt, interim progress report 3; unpublished, EXTECH III Yellowknife Greenstone Belt Project (63 p., 1:50,000 map).

Thompson, P.H. 2002a. First steps toward a new metamorphic framework for gold exploration west of Timmins, Central Abitibi Greenstone Belt, Ontario Canada; internal report for Placer Dome Canada Ltd - Dome Mine (34 pages, page size metamorphic maps of eight townships).

Thompson, P.H. 2002b. Metamorphic Data Table for Ontario Geological Survey Thin Sections (341) from the Townships of Bristol, Carscallen, Denton, Deloro, Keefer, McKeown, Ogden, Thorneloe, Tisdale, and Whitney; internal report, Placer Dome Canada Ltd - Dome Mine (supplement to Thompson 2002a).

Vaillancourt, C. 2000. Project Unit 00-011. New geological mapping and compilation in the Timmins West area - Bristol and Ogden townships; *in* Summary of Field Work and Other Activities 2000, Ontario Geological Survey, Open File Report 6032, p.4-1 to 4-11.

Vaillancourt, C., Pickett, C.L. and Dinel, E. 2001. Precambrian geology, Timmins West – Bristol and Ogden townships; Ontario Geological Survey, Preliminary Map P.3436, scale 1:20 000.

Appendix 1 (Table 2)

Metamorphic Data (Location, Mineral Assemblages, Modes, Textural Observations, Alteration)

Legend for Table 2: Metamorphic Data

Mineral Name Abbreviations:

act - actinolite
am - amphibole
ap - apatite
bt - biotite
cb - carbonate
cht - chlorite
cp - chalcopyrite
cpx - clinopyroxene
ctd - chloritoid
cum - cummingtonite
cz - clinozoisite
ep - epidote
epg - epidote group minerals
fp - feldspar
gra - graphite
gru - grunerite
grt - garnet
he - hematite
hn - hornblende
ilm - ilmenite
kf - potassium feldspar
ms - muscovite
mt - magnetite
mym - myrmekite
mz - monazite
oam - orthoamphibole
ol - olivine
op - opaque minerals
opx - orthopyroxene
oth - other
ox - oxide
p - paragonite
phl - phlogopite
plg - plagioclase,
c - calcic (An>20), s - sodic (An<3)
po - pyrrhotite
prn - prehnite
ps - pseudomorph
pu - pumpellyite
py - pyrite
qtz - quartz
ru - rutile
se - serpentine
stp - stilpnomelane
su - sulphide
tc - talc
tit - titanite
to - tourmaline
un - unknown
wm - white mica,
most commonly muscovite
zi - zircon
zo - zoisite

Other Symbols:

x - >10 modal percent
o - 1-10 modal percent
t - < 1 modal percent
- no symbol = not present
? - identity or modal % uncertain
x) (x) - mineral is partly, completely pseudomorphed
1 - main-phase metamorphism
2 - secondary/alteration mineral
r - relict igneous grains

Metamorphic Grade: (see Table 1 in text of report for details)

L - low or lower grade
T - transition grade
H - higher grade
U, T/H - grade uncertain
L? - most likely low grade

Townships (Tp):

B - Bristol
C - Carscallen
D - Denton
De - Deloro
K - Keefer
M - McKeown
O - Ogden
T - Thorneloe
Ti - Tisdale
W - Whitney

Other Abbreviations:

altd - altered
ampb - amphibolite
ampb/mgbro - derived from gabbro
amyg - amygdules, amygdaloidal
aren - arenite
brx - breccia
cgl - conglomerate
cgr - coarse grained
clsl - calcsilicate
core - core of metamorphosed pillow
cren - crenulation, crenulated
defmd - deformed
fel - felsic
Fe fm - iron formation
fgr - fine grained
fmvo - felsic metavolcanic
fln - foliation
fol - foliated
gnss - gneiss
grnst - greenstone
grnst/ampb - transition grnst to ampb
grnst/mgbr - derived from gabbro
grtd - granitoid
gsr - grain size reduction
hetero - heterolithic
HSZ - high strain zone
ign - igneous
imvo - intermediate metavolcanic
int - intermediate
interform - interformational
ipm - interpillow material
lam - laminated
lin - lineation, lineations
lyr - layer, layers
lyrd - layered
m - meta
maf - mafic
mdior - metadiorite
megax - megacrystic
mepclt - meta-epiclastite
mgbr - metagabbro
mgrdt - metagranodiorite
mgrnt - metagranite
mgrtd - metagranitoid
mgwke - metagreywacke
mmvo - mafic metavolcanic
mtonl - metatonalite
mumaf - meta-ultramafic
mvlcl - metavolcaniclastite
mvo - metavolcanic
mylon, myl - mylonite
phenos - phenocrysts
phyl - phyllite
pill - pillows, pillowed
porph - porphyry, porphyritic
pref - preffered
pste - psammite
qfp - quartz feldspar porphyry
rexl - recrystallized
rk - rock, rocks
scst - schist
sed - sedimentary
segr - segregation
selv - pillow selvage
silic - silicate
spher - spherules, spherulitic
variol - varioles, variolitic

Table 2. Metamorphic data (location, mineral assemblages, modes, textural observations, alteration).

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
1	K	81A0005	grnst/mmvo, amyg	17u	440139	5348847	L						x	x		x						t?	x			
2	K	81A0055	grnst/ampb (cht fol)	17u	441859	5349786	T			x			o 2?	x		o	x				o	o				
3	K	81A0056	fel mvo rk	17u	442721	5349499	L	o		x			o	o								o	o			
4	K	81A0119	grnst (90% act)	17u	438920	5348597	L							o		x						t				
5	K	81A0184	fol bt-cum mepclt	17u	442157	5351064	H	x		x	o 2	x	o 2					o			t			/t		
6	K	81A0304	mepclt/fgr gnss	17u	441560	5349758	T	x	?	x	o	t ?	o	x							t		o	/t		stp?
			laminae folded																							
7	K	81A0310	fol grnst/mgbr	17u	442739	5349222	L/T	t		o			x	x		x						o				
			gsr																							
8	K	81A0314	cht mepclt	17u	444229	5350704	L	x		x		t r?	x								t	t				
			is bt relict ign or meta?																							
9	K	81A0346	grnst/ampb	17u	440911	5349796	T	t		o			o	x		x	x				t	t				
10	K	81A0378	grnst	17u	440911	5349796	L	t		t			x	x		x						t				
11	D	81A0008	ctd-cht-qtz aren/phyl	17u	448859	5353888	L	x			x		o										t	/t		o ctd
12	D	81A0077	fol grnst/ampb	17u	448748	5352997	T	o		x				o		x	x				t	o				
13	D	81A0091	grnst/mmvo	17u	447696	5350503	L			(o)			o	x		x						o				
14	D	81A0098	grnst, altd?	17u	446830	5350385	L			x			x	x									x			

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
15	D	81A0099	ep-cht-bt mepclt	17u	447301	5352389	H	x		(x)		o	o	x							o					
16	D	81A0121	mumaf rk	17u	453763	5354340	T	t		t			x			x		x/			x		t			
17	D	81A0122	grnst/fgr mgbr/mmvo	17u	453804	5354278	L	t		t			x	x		x						o				
			chemistry looks wrong																							
18	D	81A0123	grnst/fgr mgbr/mmvo	17u	453762	5354124	L			x			x	x		x					t	o				
19	D	81A0125	fol grnst	17u	455169	5352537	T			x			o	o	x						t	t				
20	D	81A0162	amyg grnst/mmvo	17u	453657	5354001	L	o		o			x	x		x						x				t un
21	D	81A0163	altd (cb-wm)mepclt	17u	453758	5353891	L				x		o									o	o			
			relatively high Na2O K2O																							
22	D	81A0166	fmvo rk	17u	452239	5356606	L	o		x	x		o								t	t	o	/t		
23	D	81A0218	meta-ultramafite	17u	452671	5351662	T						x			x					o		o			
24	D	81A0215	grnst/mgbr	17u	455579	5356672	L	o		o			x	x		x					t					
25	D	81A0219	meta-ultramafite	17u	452547	5351712	T						x	t	x						o					
26	D	81A0341	grnst/ampb	17u	448635	5354168	T	o					x	x		x	o					o	o			
			cb-act-qtz zones																							
27	D	81A0382	fol grnst/mmvo	17u	446353	5349233	L			(x)			x	x	o	x					t	o				
28	D	81A0400	meta-ultramafite	17u	454684	5353684	L			t	x tc		x								o		x			
29	D	81A0406	fol grnst/mmvo	17u	453312	5351967	L	o					o	x		x					t	t				
30	D	81A0407	meta-ultramafite	17u	452869	5351460	T						x		x						o					

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
31	D	01LAH-003	fel mepclt	17	448890	5353820	L	x			x		x	o							x su			/t		
32	D	01LAH-004a	mepclt/sed rk	17	449240	5353944	L	x		(?)	x		x	x							t			/t		t un
33	D	01LAH-004b	mvlcl rk	17	449240	5353944	L	x		(x)?	x		x	x									t			
34	D	01LAH-004c	grnst	17	449240	5353944	L	t		t			x	x		x					t	t				
35	D	01LAH-008	cht-cb-qtz HSZ	17	448867	5352761	L	x		?			x								t					
36	D	01LAH-010	mepclt	17	448787	5352621	L	x			t		x	x									x			
37	D	01LAH-012	meta-altd qtz porph?	17u	451724	5356908	L?	x			x										x su					
38	D	01LAH-013	meta-altd qfp	17u	451622	5356847	L	x		x	x		o								t		o			
39	D	01LAH-037	altd ampb/mumaf	17u	449520	5354494	H				x		x								o		x			
40	D	01LAH-077a	meta-Fe fm, act-rich	17u	455119	5352162	T	t					t	t	x	x?		/x?								
			fol/lin?																							
41	D	01LAH-080	fol ampb	17u	453872	5352098	H	o		x	o 2						x				o					
			vein											x												
42	D	01LAH-081a	ultramafic mvo rock	17u	453722	5354117	L?				x tc?		x								x		x			x se
43	D	01LAH-083	grnst/mmvo	17u	449357	5354764	T	t		t				x		x	x				t	t				
			vein																				x			
44	D	01LAH-084	hn mtonl	17u	449519	5354812	L	x		x		(t)	t 2				o				t	t				
45	D	01LAH-085	cht-epg-qtz mbrx	17u	449575	5354929	L	x					x	x							t	o				

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
46	D	01LAH-092	grnst, pillow margin	17u	448682	535419	L						o	x	x						t	t				
47	D	01LAH-096	altd/mineralized mtonl	17u	452110	5356455	L	x			x 2		x 2								x su			?/		t un
			intense defmd qtz vein																							
48	D	01LAH-096a	qtz-cht-wm HSZ	17u	452113	5356450	L	x			x		t								t					
			intensely fol																							
49	D	01LAH-102a	mumaf rk	17u	453783	5354312	H						o					x/								o se
50	D	01LAH-102b	fgr mgbr/grnst	17u	453783	5354312	L			x			o	x		x					t	t				
			vein					x								x							x			
51	D	01LAH-104	fol grnst	17u	452128	5355611	L	t		o			x	x		x					t					
			vein										x	x												
52	D	01LAH-105c	grnst/mmvo	17u	452214	5355772	L	t		o			x	x		o					t		t			
			vein										o	x												
53	D	01LAH-107	fol grnst	17u	453996	5352193	L	t		x			t	o		x					t		t			
54	D	01LAH-109	mgbr/mumaf rk	17u	453996	5351847	T						x		x						o					
55	D	01LAH-111a	fol ampb gnss, clsl lyr	17u	453702	5350397	H	x		x				x		x	x		t			t				
56	D	01LAH-111b	ampb gnss	17u	453702	5350397	H	o		x	o 2	t					x				t	t				
57	D	01LAH-111c	fol ampb/mgbr	17u	435702	5350397	H	t		(x)	x 2						x				o					
			cut by HSZ				H			(x)							x									
58	D	01LAH-111d	younger ? mdiabase	17u	435702	5350397	L	t		x			o			o			o r?			t	t			
			massive																							
59	D	01LAH-111e	mgrdt	17u	453702	5350397	H?	x	o	x		t		t												

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
			gsr																							
60	D	01LAH-111g	grtd lyr + clsl gnss	17u	453702	5350397	T																			
			maf lyr					t		o				x		x	o					t				
			fel lyr					x	o	x		t		t												
61	D	01LAH-112	mtonl/mgrdt	17u	453244	5349675	H	x	o	x		t	t 2	t												
			weak fln																							
62	D	01LAH-113a	"mylon" gnss/imvo	17u	452928	5349603	L	x	o	x			o	o		o					t	t				
			fragment/clast					x	x																	
63	D	01LAH-113b	kf megax bt mgrnt	17u	452928	5349603	H	x	x	x		t	t 2	t												
			wk fln, bt "polygonized"																							
64	D	01LAH-113d	imvo/mepclt	17u	452928	5349603	T	o	t	x				x		x	x					t				
			intense fln																							
65	D	01LAH-115a	kf megax bt epg mgrnt	17u	452447	5349452	L	x	x	x		o		o			t					t		t/		
			fln prominent																							
66	D	01LAH-119	fol ampb/mgbr	17u	450356	5351149	H	t		x	o 2			o			x				t	t				
67	D	01LAH-120b	epg-hn-bt mepclt	17u	450286	5351578	H	x		o		o	t	x			x				t	t		/t		
68	D	01LAH-121a	clsl gnss/mepclt		450279	5351706	H	x		x	t 2			x		x	x				t	o				
69	D	01LAH-121b	fol ampb	17u	450279	5351706	H	x		x				t			x				t	t				
70	D	01LAH-124	act-cht-cb schist	17u	452865	5352837	L	t					x			x						t	o			
			fln, cren, low epg, op																							
71	D	01LAH-125	qtz-wm-cht phyl/scst	17u	452855	5352670	L	x		?	x	t?	x											/t		t stp?

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
72	D	01LAH-126	clsl gnss/mepclt	17u	449449	5351880	T	x		x		t	o 1,2	x		x	x				t	t				
			"clasts"/boudined layers																							
73	D	01LAH-133a	clsl gnss/mepclt	17u	449081	5352203	T	x		x	o 2		x	x		x	x				t	t				
74	D	01LAH-133b	fol mtonl	17u	449081	5352203	L	x		x		o	t 2									t		t/	t	t prn?
75	D	01LAH-145d	wm-cht-qtz-cb phyl/scst	17u	452206	5352604	L	x		o	x		o								t		x			t ru?
			cren fln																							
76	D	01LAH-147	qtz-wm-cht-bt phyl	17u	452328	5352786	T	x		o	x	t	o								t					
			cren fln																							
77	D	01LAH-148	mumaf/Fe fm	17u	451879	5352527	T						x	t				x			t		t			
		(014b on TS)	fol																							
78	D	01LAH-149	cht-am scst/ultramaf?	17u	452025	5351894	T						x					x/			o					
79	D	01LAH-150	ampb/grnst	17u	452234	5351882	T	t		o					x									t/		
			vein?					x	?	?			x													
			wm-qtz leuco zone					x			x 2			x												
80	D	01LAH-152	mumaf rk	17u	452626	5351450	L						x								x		x			x se
81	D	01LAH-153	fol meta-qfp	17u	452777	5351629	H	x	x		t	o	o 2	t												
			mepclt																							
82	D	01LAH-154	fol ampb	17u	452691	5351862	H			o	o 2						x				t	o				
83	D	01LAH-167b	am-bt meta-ign rk	17u	447243	5349138	T			x		x	o 2	x		x	?	?			t	t	t			
			meta-lamprophyre?																							

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
84	D	01LAH-171	hn-cht-ep-ps ampb	17u	446592	5350886	H			x			o 1,2	o			x				o	o				
			altd?																							
85	D	01LAH-176	cht-epg mepclt	17u	447483	5352177		x	?	x			x	o?							t	o				
86	D	01LAH-182	cb-cht-wm phyl	17u	447267	5349389	L	o	?	?	o		x								t		x			
			mepclt/HSZ																							
87	D	01LAH-185	fol cb-cht mepclt	17u	447652	5349660	L	x		x	o?		x								t		x			o tc?
88	D	01LAH-186b	cb-cht-wm phyl	17u	447665	5350360	L				o		x								t		x			
			mumaf if wm = tc, altd?																							
89	D	01LAH-186c	lam qtz-cb-wm phyl	17u	447712	5350405	L	x			x		t								t	t?	x	/t	t	
			fln/lyr cren, altd?																							
90	D	01LAH-186e	grnst/mgbr	17u	447695	5350315	L			o			o	x		x	t r				t					
			cren fln																							
91	D	01LAH-198	qtz-wm-cb-cht HSZ	17u	447807	5350236	L	x		x	x		x										x			
			cren fln																							
92	D	01LAH-199	qtz-cb-cht HSZ	17u	447805	5350273	L	x	x?	x?			x								o	o				
			mepclt?																							
93	D	01LAH-205	qtz-cb-cht-wm phyl	17u	447351	5349665	L	x		x	x		x										x			
			HSZ, s-c planes, altd?																							
94	D	01LAH-211	fol fel mepclt	17u	447746	5350781	L	x		x	o		o	x?							t	o?				
95	D	01LAH-213	mbrx, unknown	17u	450017	5354811	T	x				t	x	x		t	t					x				
96	D	01LAH-214'	qtz-wm-cht-cb phyl	17u	450857	5354106	L	x			x		x								o		x			
			HSZ/mepclt?																							

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
97	D	01LAH-574'	fol fel meta-ign rk	17u	449187	5348524	U	x	o	x	t 2	t	t 2	o												
98	D	01LAH-576a	fol mgrdt/tonalite	17u	449085	5348694	L?	x	?	x		(o)	t 2				o					t		t/	t?	
99	D	01LAH-576b	(bt) mgrdt/mtonl	17u	449085	5348694	L	x	?	x		(o)	t 2									t		t/		
100	D	01LAH-602a	fol hn-ep-bt mepclt	17u	452610	5350362	H	x		x	o 2	t		o			x					t				
			vein											x												
101	B	81A0009	mumaf rk	17u	456612	5358449	L				x tc										x		x			x se
102	T	81A0010	ampb/grnst mmvo	17u	458599	5356896	T						o	x		o	x				t		t			
			hn epg limited to amyg?																							
103	T	81A0142	fol grnst/phyl	17u	457618	5353044	L	o		x	o 2	t	x 1,2	x		x										
			possible interpillow																							
104	T	81A0143	ampb/mmvo	17u	458267	5352931	H	o		o							x				t	t				
105	T	81A0145	grnst/ampb	17u	456998	5356708	T			(x)	o 2			x		o	x				t	t				
106	T	81A0213	fmvo flow	17u	459659	5356857	L		?	x	x		o	x									t			
107	T	81A0214	wm-cht mepclt	17u	459772	5356888	L	x	x?	x?	x		o	o							t					
108	T	81A0427	amyg ep-bt ampb	17u	457205	5354760	H	t		t		o	o	x		o	x				t	o				
			act-cht amyg																							
109	T	01LAH-002a	mumaf rk	17u	456982	5352684	L				o											t	x			x se
110	T	01LAH-002b	mumaf rk	17u	456982	5352684	L				t										t		x			x se
111	M	01LAH-001	bt mtonl	17u	457253	5345684	L	x		x	t 2	o r	o 2	t 1,2								t		t/	t	

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
112	C	00CMV-88a	fmvo rock	17u	455821	5365937	L	x	?	x s	o		o								t		o			
113	C	00CMV-88b2	imvo	17u	455821	5365937	L	x	?	x	x		x								t		x			t ru?
114	C	00CMV-92a	cb-cht mepclt	17u	455787	5365793	L	o?		x			x								o		x			t ru
115	C	00CMV-415a	int meta-ign rk	17u	455802	5366530	L	x		x	o 2		x								t		o	t/	t	
			dyke, high level pluton?																							
116	C	00CMV-418a	fol fel mvo rk	17u	455692	5366435	L	x	x	x	x		x	t							t	t				
117	C	01LAH-017	cht-(bt) mtonl	17u	451811	5357780	L	x		(x)	x 2	(o)	x 2	x 2												
118	C	01LAH-022a	lyrd grnst, HSZ	17u	447205	5360077	T	o		x			x 2?	x		o	x				t	o				
119	C	01LAH-022b	bt-hn mtonl	17u	447205	5360077	H?	x		x	o 2	o? r	t 2	o 2			x i					t			t	
120	C	01LAH-026	ampb/mbasalt	17u	446573	5360411	H	t		x	o 2						x				t					
			vein														x									
			vein					x						x		x										
121	C	01LAH-028	grnst/mgbr	17u	446412	5362058	L	t		x			o	o		x					t	t				
			fol, disequilib texture																							
122	C	01LAH-029A	altd ampb gnss	17u	446394	5361930	H	t?		(x)	x 2	o	o	x			x				t	o				
123	C	01LAH-032	strained altd ampb	17u	446485	5361140	H	o		(x)	o 2			o 2			x				o	o				
			vein											x												
124	C	01LAH-041a	altd mepclt	17u	452645	5358676	L	x	?	?	x		o								o			/o		
125	C	01LAH-041b	silic-oxide meta-Fe fm	17u	452645	5358676	L	x										/x			x mt					

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
126	C	01LAH-041c	maf meta-fragmental?	17u	452645	5358676	L	x				x	x	x							x					
127	C	01LAH-043a	fol fel mepclt	17u	448649	5362249	L	x	?	x	x		t								o			t/		
			plg kf? phenos, fln																							
128	C	01LAH-045a	low grade clsl rk	17u	448625	5362831	L	x		x			o	x		t					t	t	t			
129	C	01LAH-046b	fol ms-qtz meta-aren	17u	448560	5362862	L	x			x		o								t			/t		
130	C	01LAH-048a	fol fel m-crystal tuff?	17u	445882	5362595	L	x	?	x	x		o													
131	C	01LAH-048b	int mvo rk	17u	445875	5362585	L	o		x	x 2?		x	?		o					o					2un
132	C	01LAH-051d	fol fel mepclt	17u	447675	5362522	L	x	x?	x?	x		o													
			vein																							
133	C	01LAH-054	grt hornblendite	17u	447004	5362536	H					t					x			t	x					
			limey Fe fm?																							
134	C	01LAH-056	fol epg ampb	17u	446487	5362586	H?	o		x	t 2		t 2?	o			x				t					
			vein											x												
135	C	01LAH-060a	fol fel mepclt	17u	446456	5362885	H	x	x?	x?	x	o														
136	C	01LAH-061	int mvo/clsl rk	17u	447054	5363382	T?	x		x			o	x												
			vein											x		o?	x									
			vein											x									x			
137	C	01LAH-061a	fel mepclt	17u	447054	5363382	T?	x		x	x 2	(?)	o	x							t	t	t			
138	C	01LAH-061b	meta-Fe fm	17u	447054	5363382	T	x				t	t 2				o	/o			o					
139	C	01LAH-074	meta-Fe fm	17u	452274	5358589	H	x							x						x		t			x stp

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
140	C	01LAH-103a	fol grnst/fgr mgbr	17u	455628	5357692	L	t		x			x	x		x					t	t				
141	C	01LAH-103b	maf mepclt/phyl	17u	455628	5357692	A	x					x										x			x un
			high strain zone																							
142	C	01LAH-219a	fel mvo rk	17u	455755	5366329	L	x	?	x	t		o	t							t		o			
143	C	01LAH-219b	altd maf meta ign rk?	17u	455755	5366329	L	x		x	x		x								t	t	x			
			mepclt?																							
144	C	01LAH-220	cht mtonl	17u	455869	5366521	L	x		x	x 2		x	x							t	t	o			
			qtz-fp intergrowths																							
145	C	01LAH-221	grnst/pillow selvage	17u	455858	5365874	L	o		x			x	x							t	t	x			
146	C	01LAH-225	fel mvo rk	17u	454147	5365747	L	x	?	x	x 2	t?	o													t stp?
147	C	01LAH-226	fel volcaniclastic rk	17u	454202	5365378	L	x	x?	x?	x		x										x		t	
148	C	01LAH-522a	fol amyg grnst	17u	449556	5362905	L	o		x			x	x		x					t					
149	C	01LAH-522b	stp-cht-qtz mFe fm	17u	449556	5362905	L	x					x								mt su					o stp
150	C	01LAH-522c	altd mmylon/fmvo	17u	449556	5362905	L	x	x?	x?	x 2		x	x?												pu?
			fol/lam																							
151	C	01LAH-528	qtz-wm-op phyl	17u	448893	5363993	L?	x			x										x					
			alteration?																							
152	B	00CMV-001a	epg-wm mepclt	17u	461649	5361506	T	x	?	x s	o		o	o							t	t	o			
153	B	00CMV-010a	fel metahyaloclastite	17u	459711	5365795	H	x	?	x	o	t	t								o					t un2

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
154	B	00CMV-011a	fol fel mepclt	17u	459677	5365858	H	x	o?	x s	o	t	o								t					
155	B	00CMV-015a	grnst	17u	459930	5365862	L	o	?	x s		t	x	t								o	o	t/		
156	B	00CMV-016a	fel/int mepclt	17u	459779	5366549	L	x	?	x	o		x	t		t?					t		o			
157	B	00CMV-017a	fol fel mepclt	17u	459510	5366603	L	x	?	x	x		o								t		o			
158	B	00CMV-018a	cb-cht-wm mepclt	17u	460019	5363297	L	o			x		x								t		x	/t		
			fol																							
159	B	00CMV-22aa	volcaniclastic mbrx	17u	460350	5363493	L	x		x			x								o		x			o un
160	B	00CMV-22ab	cb-cht-wm phyl/HSZ	17u	460350	5363493	L	o			x		x								t		x			t ru
161	B	00CMV-023a	cht-qtz-fp mporph	17u	455899	5366546	L	x		x	x 2		x								t		o	t/	t	
162	B	00CMV-27a1	fol fel phyl/fmvo/HSZ	17u	458895	5362695	L	x	?	x s	x												o			
163	B	00CMV-28b1	cb-cht-wm phyl/HSZ	17u	458926	5362945	L	x	?	?	x		x								o		x			
164	B	00CMV-029b	grnst, qtz veins	17u	459757	5362269	L	x		o			x	x		t?					t					t un
165	B	00CMV-032a	cht-cb-prn phyl/HSZ	17u	459651	5361482	L	o			o		x								t	o	x			x prn
166	B	00CMV-41a2	grnst	17u	458130	5359831	L	o		o			x	x		x					t	t	o			
167	B	00CMV-048a	grnst	17u	457688	5360276	L	o		o			x	x		x					t					
168	B	00CMV-049b	fol blotchy stp grnst	17u	457577	5360149	L	o		x			o	x		x						o				x stp
169	B	00CMV-052a	spotted grnst	17u	457734	5360057	L			o			o	x		x						o				

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
170	B	00CMV-059a	act-epg-cht mepclt	17u	463812	5364779	T	o		(o)	o 2		x	x		o					t		x			
			vein										x										x			
171	B	00CMV-061a	cht-epg mepclt	17u	464941	5366322	T	o		o		t	x	x							t		o			
172	B	00CMV-75a1	silic-su meta Fe fm	17u	458775	5358129	T			o				o		x	o				x	o				x un
173	B	00CMV-75a2	clsl rk	17u	458775	5358129	H			x	t 2			o		o							o			x un
174	B	00CMV-75a4	clsl? rk	17u	458775	5358129	H			x	t 2		x	o		o							o			x un
175	B	00CMV-75a5	clsl/Fe fm?	17u	458775	5358129	H			x?	o	o	o			?					x		x			
176	B	00CMV-75a6	su-silic meta Fe fm	17u	458775	5358129	U	x		x?		t	t										x			x py
177	B	00CMV-087a	int plg mporph	17u	455880	5365837	L	o		x	o		x								t		x			t ru
			vein, rexl					x															x			
178	B	00CMV-100a	altd defmd fmvo	17u	458636	5357792	L	x	?	x s	x										x		o			t un
179	B	00CMV-101a	Na am meta? syenite	17u	458699	5357517	U		x			t			x				t			t	t	t/	t/	
180	B	00CMV-106a	cb-su-wm "marble"	17u	459211	5364200	L	o			o										x su		x			
181	B	00CMV-109a	fmvo/qfp	17u	459443	5364601	L?	x	?	x	x										t		t			
182	B	00CMV-114a	meta-aplite/arkose	17u	458692	5357235	U	o	x ?	x s?											t		t			
183	B	00CMV-118a	epg alt or grnst	17u	457774	5357986	T		x	x			x 2?	x 1,2	x		?				t	t				
			vein											x												
184	B	00CMV-124a	fol maf mvlcl, altd?	17u	458983	5361477	L	t		(x)	x		x	x		x										
185	B	00CMV-125aa	cb-cht-wm mepclt	17u	459225	5359023	L	t			x		x								t		x			

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
			fol lam																							
186	B	00CMV-125ab	fol cb-cht rk	17u	459225	5359023	L	t			t		x										x			
			vein																				x			
187	B	00CMV-252a	wm-cht-to mepclt	17u	465331	5357559	L	x		x	x		o								t		o	/o		
188	B	00CMV-259a	fol grnst	17u	455983	5358569	L	o		x			x	x		x										
			vein					x					x	x												
189	B	00CMV-260a	cb-epg-qtz mepclt	17u	457006	5358857	L	x			o		o	x									x			
			in high strain zone																							
190	B	00CMV-267b	int? mvo rock	17u	459894	5358092	L	o		x			o	x							t					x un
			amyg?variol?																							
191	B	00CMV-267c	fel mvolcaniclastic	17u	459894	5358092	L	x	x ?	x	o		o								t					
192	B	00CMV-286a	wm-cht mepclt	17u	459263	5358619	L	x	?	x	x		o								t		o	t/t		
193	B	00CMV-298a	defmd mgrnt?	17u	459283	5357203	L?	x	x	x			o								o		o			
194	B	00CMV-300a	wm-cht-cb mepclt	17u	458926	5357127	L	x	?	x	x		o										x			
195	B	00CMV-429a	fel mepclt	17u	457791	5365863	H	x	x ?	x	x	o	t										o			
196	B	00CMV-431c	mFe fm/syenite	17u	457442	5357802	L		x	?				t		o			x			x 1,2	t	t/		o un
197	B	00CMV-507a	wm-cb mepclt	17u	465124	5362877	H				x										x	x	x			x phl
			phl?, blebby																							
198	B	00CMV-519a	cb-wm-cht mepclt	17u	464374	5362327	L	x	x ?	x s	x		o								t		x		t	t ru
			fol																							

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
199	B	00CMV-601a	fol ep-wm-cht mepclt	17u	464530	5361973	T?	x	?	x	x		o	o									o			
200	B	00CMV-602a	cb-wm-cht fel mvlcl	17u	464821	5361845	L	x	?	x s	x		o	t									o			
			intense fol																							
201	B	00CMV-602b	fol fel wm-cht-cb mvlcl	17u	464821	5361845	L	x	?	x s	x		o										x	/t		t ru
202	B	00CMV-638a	fol cht-cb mepclt	17u	464721	5361917	L	x		x	x		x													t ru
203	B	00CMV-638b	fol wm-cht-cb mepclt	17u	464721	5361917	L	x		x	x		x									o	o			
204	B	00CMV-639a	fol wm-cht-py mepclt	17u	464627	5361972	L	x		x	x		x								x py		o			
205	B	00CMV-639b	fol wm-cht mepclt	17u	464627	5361972	L	x		x	x		o	t							t					
206	B	00CMV-639c	qtz-fp mporph	17u	464627	5361972	L	x	x	x	x											t	o			t ru?
207	B	00CMV-639d	fol wm-cht-cb mepclt	17u	464627	5361972	L	x	?	x s	x		o								t		o			
208	O	00CMV-202b	cht-wm-epg mepclt	17u	474783	5361920	L	x	x ?	x	o		x	o									o			t ru
209	O	00CMV-206e2	su-qtz meta Fe fm	17u	474154	5362193	L	x					o								x su		o			
210	O	00CMV-206g	lam wm-cht phyll	17u	474154	5362193	L	x		?	x		o								o		o	/t		
			vein					x															x			
211	O	00CMV-212a	meta-komatiite	17u	475061	5360027	H						t	t				x/			o					
			vein					x																		
212	O	00CMV-218a2	mumaf rk	17u	472376	5362165	L				x tc		x								o		x			
			fol cht seams																							
213	O	00CMV-218d	fol qtz-fp mporph	17u	472376	5362165	L?	x	?	x	x										t		o			t ru

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
214	O	00CMV-219b	wm-cht-cb mepclt	17u	472300	5361818	L	x	?	x	x		o										x	/t		t ru
			vein					x															x			
215	O	00CMV-220a1	fel mvolcaniclastic rk	17u	472841	5361900	L	x	o	x	x		o	x								t				
			wk fol, hetero texture																							
216	O	00CMV-220a2	cht-wm-cb mepclt	17u	472841	5361900	L	x	?	x	x		x	x									x			
217	O	00CMV-222a	fel mvlcl	17u	472199	5361259	H	x	?	x			t	x	t								o			
218	O	00CMV-223a1	metadunite/serpentinite	17u	472041	5361105	L				x tc										o		o			x se
			rims of tc se																							
219	O	00CMV-224a	grnst/mgbr	17u	472224	5361177	L	t					t	x		x										
220	O	00CMV-232a	mepclt	17u	471210	5365002	L	x		x	x		o									t			t/t	
221	O	00CMV-234a	bt mgrnt	17u	469536	5359826	L	x	x	x	t 2	o)	t 2	o 2								t				
222	O	00CMV-241a	cht-cb mepclt	17u	471950	5364233	L	x			o		x													
			qtz-cb-su vein, altd					x													x su		x			
223	O	00CMV-241b	cht-epg-cb mepclt	17u	471950	5364233	T	x	?	x			x	x							t	o	x			
224	O	00CMV-243a	mumaf rk	17u	474921	5363502	H?						o		x?		x?/				o	t	t			
225	De	00CMV-244a	cht-cb-qtz phyl/mmyl?	17u	476164	5358722	L	x	?	x			x									t?	x			
			intense fol																							
226	De	00CMV-245a	altd?/meta? Diabase	17u	476032	5358792	L			x		t			o		t			x	o			t/		o ps
227	O	00CMV-247a	cb-rich mepclt	17u	475290	5366575	L	x	?	x			x										x			o ru

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
228	O	00CMV-250a	HSZ/mepclt?	17u	475173	5363613	H	x	?	x			x	x		x										x un
229	O	00CMV-263a	fol cb-cht/se mbrx	17u	466586	5361918	L	o ?			t tc?		o ?								t		x			o se
230	O	00CMV-274b1	fmvo rk	17u	471427	5362716	L	x	x ?	x s			x										x			o ru
231	O	00CMV-302b	grnst/mgbr	17u	474750	5363525	L			x			o	x		x				t r	t					
232	O	00CMV-305a	bt mgrtd	17u	473823	5363324	L	x	x	x s	o 2	(o r)	o 2	o							t					twm1
233	O	00CMV-401a	fol act-cht mepclt	17u	475082	5359242	T	x		x s			o			x					t	t	x			
234	De	00CMV-403a	fol hn-act ampb	17u	475439	5359266	T	o		o				x		x	o					o				
235	O	00CMV-701a	fol mumaf rk	17u	473688	5362197	L				x tc		x								x		t			
236	O	00CMV-702b	fol cht-wm-cb mepclt	17u	473783	5362249	L	x	?	x	x		o								t		o	/t		
237	O	00CMV-705a	fol mumaf rk	17u	471537	5362548	L				x tc		x								x					
			relict spinifex																							
238	O	00CMV-706c	fol mumaf rk	17u	471637	5362576	L				x tc		o													t ru
239	O	00CMV-706d	HSZ/mepclt?	17u	471637	5362576	L	x	?	x	o 2		x								t		x			
240	O	00CMV-708a	fel mvlcl	17u	471814	5362708	L	x		x	x		o								t					
241	O	00CMV-709a	mvolcaniclastic rk	17u	471714	5362482	L	x	?	x	x		o 2	x	o											
242	O	00CMV-709b	fmvo, variol?spher?	17u	471714	5362482	L	x	?	x	x		x								o					
243	O	00CMV-807g	grnstpill/ipm	17u	466946	5363321	L	x		o			o	x		x					x		x			
			fln cren																							

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
244	O	00CMV-809b	cht-wm-cb mepclt	17u	467273	5362068	L	x	?	x	x		o								t		x			
245	De	00CMV-278a	mumaf rk	17u	476750	5359771	L														o		x			x se
246	Ti	BH87-247	cht-wm mepclt	17u	484664	5366785	L	x		x	x		x								t			/t		t ru
247	Ti	DP88-035	mumaf rk?	17u	481792	5367767	T						o		x											
			vein																				x			
248	Ti	DP88-039	grnst/fgr mgbr/flow	17u	482295	5367200	L			x			x	x		x						o				
			weak pref orientation																							
249	Ti	DP88-043	grnst/fgr mgbr	17u	482926	5368182	L			x			o	x		x						t					
250	Ti	DP88-068	wm-cb-cht mepclt/msed	17u	479370	5370420	L	x		x	x		x										x			
251	Ti	DP88-070	cgr cht-wm mepclt	17u	481524	5367818	L	x		x	x		x								o		o			
252	Ti	DP88-101	cht-wm-cb mvlcl/mcgl	17u	481524	5367818	L	x	?	x	x		x								t		x			
253	Ti	DP88-106	meta-interformcgl	17u	482659	5369196	L	o			x		o								t		x	/t		t ru
254	Ti	DP88-108	cht-cb mepclt	17u	479370	5370420	L	x	?	x			x										x			
255	Ti	DP88-110	cht-wm mepclt	17u	482904	5370976	L	o	?	x	o		x								t				t	t ru
256	Ti	KK87-175	cht-wm phyl/HSZ	17u	484201	5367343	L	x		x	x		x										o			t ru
257	Ti	KK87-177	cht-wm phyl/psammite	17u	484660	5369022	L	x		x	x		x	t ?												
			two fins																							
258	Ti	KK88-010	grnst/mumaf	17u	475759	5373557	L				t		o		x							t				

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
259	Ti	KK88-033	cb-cht-qtz-fp phyl	17u	477829	5370446	L	x		x			x										x			
260	Ti	KK88-036	cb-cht-wm mepclt	17u	479648	5367745	L	x		o?	x		x								t		x	/t		t ru
261	Ti	KK88-136	wm-cht-cb mepclt	17u	479010	5369010	T?	x		x	x	t?	x								t		o			
262	Ti	KK88-151	fol cht-wm-cb mepclt	17u	480126	5368847	L	x		x	x		o										o			
263	Ti	KK88-204	int meta-ign rk	17u	480036	5369633	L	o		x			x								t	t	o	/t		
264	Ti	KK88-205	cht-wm-cb mepclt	17u	476890	5369307	L	o			x		o										x			
265	Ti	KK88-218	wm-cht-stp mepclt	17u	481732	5368266	T?	x		x	x		x										o			t stp
			moderate fln, t of ru																							
266	Ti	KK88-223	cht-wm-stp? mepclt	17u	482444	5368800	T?	x		x	x	t?	x										t			t stp
267	W	BH87-009	serpentinite/mumaf	17u	486221	5368511	L														o		t			x se
268	W	BH87-047	cht-cb-wm mepclt	17u	486352	5367219	L	x		x	o		x										o			o ru
269	W	BH87-072	cht mepclt	17u	485948	5366633	L	x	?	x	t		x	o								t	t			
270	W	BH87-103	cht-wm-cb mepclt/HSZ	17u	484961	5367311	L	x		x	x		x	t									x			t ru
271	W	BH87-116	wm-cht-qtz-fp schist	17u	486834	5367486	L	x		x	x		o										o			
272	W	BH87-157	fol wm-cht-cb mepclt	17u	487667	5367444	L	x		x	x		o										x			
273	W	BH87-169	mumaf rk	17u	487802	5367503	L				o tc										t		o			x se
274	W	BH87-284a	wm-cht-cb mepclt	17u	486258	5368074	L	x		o	x		o										o			t ru
			cren of fln																							

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
275	W	BH87-284b	wm-cb-cht mepclt	17u	486258	5368074	L	x			x		o										x	/t		t ru
			main fabric is cren																							
276	W	DP87-003a	meta Fe fm	17u	485614	5367509	U	x													o					o un
277	W	DP87-005	mqtzaren/mFe fm	17u	485635	5367846	U	x																		o un
278	W	DP87-006a	ctd-qtz meta-arenite	17u	485625	5367948	L	x			x		x										(o)	t/o		xctd
279	W	DP87-006b	ctd-ru-qtz-wm phyl	17u	485625	5367948	L	x		?	x															xctd o ru
280	W	DP87-008	siliceous marble	17u	485674	5368154	L	o					o										x			
			primary cb/pre-meta altd?																							
281	W	DP87-010	psammitic phyl	17u	485990	5368183	L	x		o	x		o										x			
			main fln cren, HSZ?																							
282	W	DP87-019	fel mvolcaniclastic rk	17u	485779	5368333	H?	x	?	x	x	t	x								t					
			fol, gsr																							
283	W	DP87-020	mumaf rk	17u	485799	5368373	L				o tc?										o		x			x se
			vein																				x			x se
284	W	DP87-021	mumaf rk	17u	485827	5368216	L														x		t			x se
285	W	DP87-022	wm-cb cht mepclt	17u	485803	5368522	L	o			x		x										x			t un
286	W	DP87-024	cht-wm phyl (msed)	17u	485799	5368631	L	x		x	o		x								o		o			
287	W	DP87-025	cb-cht-wm mepclt	17u	485838	5368761	L			o	x tc?		o								t		x			
			(if wm is tc, mumafite)																							

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
288	W	DP87-026	cb-wm mepclt	17u	485247	5368891	U	x		x s	x										t	t	x			t ru
289	W	DP87-029	cht-wm phyl	17u	485970	5367776	L	x		x	x		x								?	t				t ru
290	W	DP87-031	wm-cht mepclt	17u	486048	5368292	L	x		x s	x		o									t				
291	W	DP87-036	mumaf rk	17u	486029	5368451	L				x tc										o		x			x se
292	W	DP87-037	cht-cht-wm-cb mFe fm	17u	485972	5368571	L	x			x		o										x			octd
293	W	DP87-041	wm-cht-cb mepclt	17u	486393	5368094	L	x		x	x		x										x	/t		
			cren fln																							
294	W	DP87-042	fol cb-cht mepclt	17u	486422	5368162	L	x	?	x			x										x			t ru
295	W	DP87-042b	fol wm-cht mepclt	17u	486422	5368162	L	x		o	x		x								t					
			two fln																							
296	W	DP87-043	qtz-fp-wm-cht mbrx	17u	486395	5368918	L	x	?	x	x		x													
			gsr not annealed																							
297	W	DP87-051	fol kf mporph	17u	487279	5369572	H	x	x	x s	o	t									t	t	o			t ru
298	W	DP87-053	grnst/fgr mgbr	17u	487355	5369095	L			x			x	x		x						o				
299	W	DP87-054a-1	chemical msed rk	17u	487423	5369602	L	x			x		x								o		x	/t		
			main + later fln																							
300	W	DP87-054a-2	wm-cb-cht mepclt	17u	487423	5369602	L	x			x		o								x		x	/t		
301	W	DP87-055	cb-cht-wm mepclt	17u	488931	5370433	L	x		x	o		x								t		x		t	t ru
302	W	DP87-057	altd mporph	17u	489142	5370543	L						x								x		x			

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
303	W	DP87-063	fol epg-bt mepclt	17u	491024	5371901	H	x		x s	x	t	x	x							t			/t		
304	W	DP87-065	wm-cht-epg mepclt	17u	494563	5373383	L	x		x	x		o	x							t	t				
			fol																							
305	W	DP88-001	wm-qtz mepclt	17u	487961	5369790	L	x		o	x	(t)?	o								t	t	o			
306	W	DP88-003	fol wm mepclt	17u	487884	5369631	U	x			x										(t)		t			
			cren fln																							
307	W	DP88-011	cht-wm mepclt	17u	487578	5370267	L	x		x	x		o								t		o			
			cren fln																							
308	W	DP88-016	wm-cht mepclt	17u	487442	5369662	L	x			x		x								t					
			cren fln																							
309	W	DP88-017	qtz-wm mepclt	17u	487606	5369680	L	x			x		x								t					
			cren of fln in wm-rich																							
310	W	DP88-018	cht-wm mepclt	17u	492847	5375039	L	x		?	x		x										t			t ru
			moderate fln																							
311	W	DP88-021	grnst/imvo	17u	492917	5375120	L			x			x	x		t ?					t		o			
312	W	DP88-022	grnst/imvo	17u	492917	5375120	L			x			x	x							t		t			
313	W	DP88-023	mumaf rk	17u	492917	5375120	T?			o	x tc		x	?				t?//				t	t			
			moderate fln																							
314	W	DP88-024	wm mepclt	17U	492947	5374917	L	x		o s	x		t												/t	
			vein					x															x			
315	W	DP88-100	cb-wm-cht mepclt	17u	492947	5374917	L	o			x		o								t		x			
			qtz fibres on op																							

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
316	W	KK87-001	fol wm-cb-cht mepclt	17u	487812	5367682	L	x		x	x		o								o		o			
317	W	KK87-016	fol wm-cht-bt mepclt	17u	486882	5367808	H	x	?	x	x	o	x											/t		
318	W	KK87-018	meta Fe fm	17u	486892	5368002	U	x													x					
319	W	KK87-019	cb-cht-qtz schist	17u	486854	5368171	L	o					x										x			
320	W	KK87-031	wm-cht-cb mepclt	17u	487227	5367734	L	x	x ?	x ?	x		o										x			
321	W	KK87-040	grnst/qtz mgbr	17u	487381	5367782	T	x		x			x			o						t	x			
322	W	KK87-040a?	fol cht-cb-plg phyl/HSZ	17u	487381	5367782	L	o		x			x								t		x			
323	W	KK87-041-1	fol mumaf rk	17u	487373	5367902	L				x tc												x			t ru
324	W	KK87-041-2	mumaf schist	17u	487373	5367902	L				x tc										t		x			t ru
325	W	KK87-044	fol cht-cb mepclt	17u	487602	5367723	L	x		x			x								t		x			
326	W	KK87-057	fol cht-wm-cb mepclt	17u	487803	5367831	L	x		x	o		x								x		(x)			
327	W	KK87-072	serpentinite/mumaf	17u	487786	5368716	L														t		t			x se
328	W	KK87-077	cht-cb-qtz schist	17u	488015	5368020	L	x					x								x		x			
329	W	KK87-078	qtz-cht-wm schist/HSZ	17u	488043	5367702	L	x			x		o								x		(x)			t ru
330	W	KK87-082a	cht-cb-wm phyl	17u	487457	5367862	L	x			x		x								t		x	/t		
			cren of fln																							
331	W	KK87-084	cht-cb schist	17u	487486	5368100	L	x		x			x								t		x			
			fol folded																							

Map No.	Tp	Sample Number	Rock Type	UTM Datum: NAD 1983			Grade	qtz	kf	plg	wm	bt	cht	epg	am	act	hn	cum/ gru	cpx	grt	op	tit	cb	ap/ to	mz /zi	oth
				Zone	Easting	Northing																				
332	W	KK87-089	mFe fm/su mineralized	17u	488147	5367433	U	o													x su					
333	W	KK87-090	mgrdt	17u	488685	5367671	L	x	x	x	t 2	o	t 2	t 2								t			t	
			wm rims on ign bt																							
334	W	KK87-092	cb-wm phyl/HSZ	17u	488581	5367870	L	x		x			x								t		x			
335	W	KK87-093	stp-cht mtonl	17u	488629	5367949	L	x		x			x								t		o		t	o stp
			cb often euhedral																							
336	W	KK87-119	qtz-fp mporph	17u	489068	5366944	H	x	o	x	x	o														
			metamorphic bt																							
337	W	KK87-122	fol wm-cht-cb mepclt	17u	488924	5367053	L	x	?	x	s		o									t	o			
			rounded clasts																							
338	W	KK87-159	fol int/maf metavolcaniclastic	17u	491075	5372250	T	x				t	x	x	o	?						o	x			
339	W	KK87-178c	cb-cht-tc schist	17u	484660	5369022	L	o		x	x tc		x								t		x			t ru
340	W	KK87-178e	cb-cht-wm-qtz schist	17u	484660	5369022	L	x			x tc	t	x										x			t ru
341	W	KK88-021	cb-cht phyl/mumaf?	17u	487158	5370785	L	o		o			x										x			

Appendix 2 (Table 3)

Summary of Location, Grade and Rock Type Data Depicted on Figure 2 (back pocket)

Table 3. Summary of location, grade and rock type data depicted on Figure 2 (back pocket). (Abbreviations for "grade" same as for Appendix 1; numbers in "rock type" column keyed to Figure 2.)

Map No.	Sample No.	zone	easting	northing	grade	rock type	township
1	81A0005	17u	440139	5348847	L	1	Keefer
2	81A0055	17u	441859	5349786	T	1	Keefer
3	81A0056	17u	442721	5349499	L	2	Keefer
4	81A0119	17u	438920	5348597	L	1	Keefer
5	81A0184	17u	442157	5351064	H	2	Keefer
6	81A0304	17u	441560	5349758	T	2	Keefer
7	81A0310	17u	442739	5349222	T	1	Keefer
8	81A0314	17u	444229	5350704	L	2	Keefer
9	81A0346	17u	440911	5349796	T	1	Keefer
10	81A0378	17u	440911	5349796	L	1	Keefer
11	81A0008	17u	448859	5353888	L	4	Denton
12	81A0077	17u	448748	5352997	T	1	Denton
13	81A0091	17u	447696	5350503	L	1	Denton
14	81A0098	17u	446830	5350385	L	1	Denton
15	81A0099	17u	447301	5352389	H	2	Denton
16	81A0121	17u	453763	5354340	T	3	Denton
17	81A0122	17u	453804	5354278	L	1	Denton
18	81A0123	17u	453762	5354124	L	1	Denton
19	81A0125	17u	455169	5352537	T	1	Denton
20	81A0162	17u	453657	5354001	L	1	Denton
21	81A0163	17u	453758	5353891	L	8	Denton
22	81A0166	17u	452239	5355606	L	3	Denton
23	81A0218	17u	452671	5351662	T	3	Denton
24	81A0215	17u	455579	5355672	L	1	Denton
25	81A0219	17u	452547	5351712	T	3	Denton
26	81A0341	17u	448635	5354168	T	1	Denton
27	81A0382	17u	446353	5349233	L	1	Denton
28	81A0400	17u	454684	5353684	L	3	Denton
29	81A0406	17u	453312	5351967	L	1	Denton
30	81A0407	17u	452869	5351460	T	3	Denton
31	01LAH-003	17u	448890	5353820	L	2	Denton
32	01LAH-004a	17u	449240	5353944	L	2	Denton
33	01LAH-004b	17u	449240	5353944	L	2	Denton
34	01LAH-004c	17u	449240	5353944	L	1	Denton
35	01LAH-008	17u	448867	5352761	L	7	Denton
36	01LAH-010	17u	448787	5352621	L	2	Denton
37	01LAH-012	17u	451724	5356908	U	8	Denton
38	01LAH-013	17u	451622	5356847	L	8	Denton
39	01LAH-037	17u	449520	5354494	H	8	Denton
40	01LAH-077a	17u	455119	5352162	T	5	Denton
41	01LAH-080	17u	453872	5352098	H	1	Denton
42	01LAH-081a	17u	453722	5354117	L	3	Denton
43	01LAH-083	17u	449357	5354764	T	1	Denton
44	01LAH-084	17u	449519	5354812	L	6	Denton
45	01LAH-085	17u	449575	5354929	L	2	Denton

Map No.	Sample No.	zone	easting	northing	grade	rock type	township
46	01LAH-092	17u	448682	5354190	L	1	Denton
47	01LAH-096	17u	452110	5356455	L	8	Denton
48	01LAH-096a	17u	452113	5356450	L	7	Denton
49	01LAH-102a	17u	453783	5354312	H	3	Denton
50	01LAH-102b	17u	453783	5354312	L	1	Denton
51	01LAH-104	17u	452128	5355611	L	1	Denton
52	01LAH-105c	17u	452214	5355772	L	1	Denton
53	01LAH-107	17u	453996	5352193	L	1	Denton
54	01LAH-109	17u	453996	5351847	T	3	Denton
55	01LAH-111a	17u	453702	5350397	H	1	Denton
56	01LAH-111b	17u	453702	5350397	H	1	Denton
57	01LAH-111c	17u	453702	5350397	H	1	Denton
58	01LAH-111d	17u	453702	5350397	L	1	Denton
59	01LAH-111e	17u	453702	5350397	U	6	Denton
60	01LAH-111g	17u	453702	5350397	T	1	Denton
61	01LAH-112	17u	453244	5349675	H	6	Denton
62	01LAH-113a	17u	452928	5349603	L	9	Denton
63	01LAH-113b	17u	452928	5349603	H	6	Denton
64	01LAH-113d	17u	452928	5349603	T	1	Denton
65	01LAH-115a	17u	452447	5349452	L	6	Denton
66	01LAH-0119	17u	450356	5351149	H	1	Denton
67	01LAH-120b	17u	450286	5351578	H	1	Denton
68	01LAH-121a	17u	450279	5351706	H	2	Denton
69	01LAH-121b	17u	450279	5351706	H	1	Denton
70	01LAH-124	17u	452865	5352837	L	7	Denton
71	01LAH-125	17u	452855	5352670	L	7	Denton
72	01LAH-126	17u	449449	5351880	T	2	Denton
73	01LAH-133a	17u	449081	5352203	T	2	Denton
74	01LAH-133b	17u	449081	5352203	L	6	Denton
75	01LAH-145d	17u	452206	5352604	L	7	Denton
76	01LAH-147	17u	452328	5352786	T	7	Denton
77	01LAH-148	17u	451879	5352527	T	5	Denton
78	01LAH-149	17u	452025	5351894	T	3	Denton
79	01LAH-150	17u	452234	5351882	T	1	Denton
80	01LAH-152	17u	452626	5351450	L	3	Denton
81	01LAH-153	17u	452777	5351629	H	2	Denton
82	01LAH-154	17u	452691	5351862	H	1	Denton
83	01LAH-167b	17u	447243	5349138	T	9	Denton
84	01LAH-171	17u	446592	5350886	H	1	Denton
85	01LAH-176	17u	447483	5352177	L	2	Denton
86	01LAH-182	17u	447267	5349389	L	7	Denton
87	01LAH-185	17u	447652	5349660	L	2	Denton
88	01LAH-186b	17u	447665	5350360	L	3	Denton
89	01LAH-186c	17u	447712	5350405	L	7	Denton
90	01LAH-186e	17u	447695	5350315	L	1	Denton
91	01LAH-198	17u	447807	5350236	L	7	Denton
92	01LAH-199	17u	447805	5350273	L	7	Denton
93	01LAH-205	17u	447351	5349665	L	7	Denton

Map No.	Sample No.	zone	easting	northing	grade	rock type	township
94	01LAH-211	17u	447746	5350781	L	2	Denton
95	01LAH-213	17u	450017	5354811	T	9	Denton
96	01LAH-214	17u	450857	5354106	L	7	Denton
97	01LAH-574	17u	449187	5348524	U	6	Denton
98	01LAH-576a	17u	449085	5348694	L	6	Denton
99	01LAH-576b	17u	449085	5348694	L	6	Denton
100	01LAH-602a	17u	452610	5350362	H	2	Denton
101	81A0009	17u	456612	5358449	L	3	Bristol
102	81A0010	17u	458599	5356896	T	1	Thorneloe
103	81A0142	17u	457618	5353044	L	1	Thorneloe
104	81A0143	17u	458267	5352931	H	1	Thorneloe
105	81A0145	17u	456998	5356708	T	1	Thorneloe
106	81A0213	17u	459659	5356857	L	2	Thorneloe
107	81A0214	17u	459772	5356888	L	2	Thorneloe
108	81A0427	17u	457205	5354760	H	1	Thorneloe
109	01LAH-002a	17u	456982	5352684	L	3	Thorneloe
110	01LAH-002b	17u	456982	5352684	L	3	Thorneloe
111	01LAH-001	17u	457253	5345684	L	6	McKeown
112	00CMV-88a	17u	455821	5365937	L	2	Carscallen
113	00CMV-088b2	17u	455821	5365937	L	2	Carscallen
114	00CMV-092a	17u	455787	5365793	L	2	Carscallen
115	00CMV-415a	17u	455802	5366530	L	1	Carscallen
116	00CMV-418a	17u	455692	5366435	L	2	Carscallen
117	01LAH-017	17u	451811	5357787	L	6	Carscallen
118	01LAH-022a	17u	447205	5360077	T	7	Carscallen
119	01LAH-022b	17u	447205	5360077	U	6	Carscallen
120	01LAH-026	17u	446573	5360411	H	1	Carscallen
121	01LAH-028	17u	446412	5362058	L	1	Carscallen
122	01LAH-029a	17u	446394	5361930	H	1	Carscallen
123	01LAH-032	17u	446485	5361140	H	7	Carscallen
124	01LAH-041a	17u	452645	5358676	L	2	Carscallen
125	01LAH-041b	17u	452645	5358676	L	5	Carscallen
126	01LAH-041c	17u	452645	5358676	L	1	Carscallen
127	01LAH-043a	17u	448649	5362249	L	2	Carscallen
128	01LAH-045a	17u	448625	5362831	L	2	Carscallen
129	01LAH-046b	17u	448560	5362862	L	4	Carscallen
130	01LAH-048a	17u	447882	5362595	L	2	Carscallen
131	01LAH-048b	17u	447882	5362585	L	1	Carscallen
132	01LAH-051d	17u	447675	5362522	L	2	Carscallen
133	01LAH-054	17u	447004	5362536	H	5	Carscallen
134	01LAH-056a	17u	446487	5362586	H	1	Carscallen
135	01LAH-060a	17u	446456	5362885	H	2	Carscallen
136	01LAH-0061	17u	447054	5363382	T	2	Carscallen
137	01LAH-061a	17u	447054	5363382	T	2	Carscallen
138	01LAH-061b	17u	447054	5363382	T	5	Carscallen
139	01LAH-074	17u	452274	5358589	H	5	Carscallen
140	01LAH-103a	17u	455628	5357692	L	1	Carscallen
141	01LAH-103b	17u	455628	5357692	L	7	Carscallen

Map No.	Sample No.	zone	easting	northing	grade	rock type	township
142	01LAH-219a	17u	455755	5366329	L	2	Carscallen
143	01LAH-219b	17u	455755	5366329	L	2	Carscallen
144	01LAH-220	17u	455869	5366521	L	6	Carscallen
145	01LAH-221	17u	455858	5365874	L	1	Carscallen
146	01LAH-225	17u	454147	5365747	L	2	Carscallen
147	01LAH-226	17u	454202	5365378	L	2	Carscallen
148	01LAH-522a	17u	449556	5362905	L	1	Carscallen
149	01LAH-522b	17u	449556	5362905	L	2	Carscallen
150	01LAH-522c	17u	449556	5362905	L	2	Carscallen
151	01LAH-528	17u	448893	5363993	L	8	Carscallen
152	00CMV-001a	17u	461649	5361506	T	2	Bristol
153	00CMV-010a	17u	459711	5365795	H	2	Bristol
154	00CMV-011a	17u	459677	5365858	H	2	Bristol
155	00CMV-015a	17u	459930	5365862	L	1	Bristol
156	00CMV-016a	17u	459779	5366549	L	2	Bristol
157	00CMV-017a	17u	459510	5366603	L	2	Bristol
158	00CMV-018a	17u	460019	5363297	L	2	Bristol
159	00CMV-022aa	17u	460350	5363493	L	2	Bristol
160	00CMV-022ab	17u	460350	5363493	L	7	Bristol
161	00CMV-023a	17u	455899	5366546	L	6	Bristol
162	00CMV-027a1	17u	458895	5362695	L	2	Bristol
163	00CMV-028b1	17u	458926	5362945	L	7	Bristol
164	00CMV-029b	17u	459757	5362269	L	1	Bristol
165	00CMV-032a	17u	459651	5361482	L	7	Bristol
166	00CMV-041a2	17u	458130	5359831	L	1	Bristol
167	00CMV-048a	17u	457688	5360276	L	1	Bristol
168	00CMV-049b	17u	457577	5360149	L	1	Bristol
169	00CMV-052a	17u	457734	5360057	L	1	Bristol
170	00CMV-059a	17u	463812	5364779	T	2	Bristol
171	00CMV-061a	17u	464941	5366322	T	2	Bristol
172	00CMV-075a1	17u	458775	5358129	T	5	Bristol
173	00CMV-075a2	17u	458775	5358129	H	9	Bristol
174	00CMV-075a4	17u	458775	5358129	H	9	Bristol
175	00CMV-075a5	17u	458775	5358129	H	6	Bristol
176	00CMV-075a6	17u	458775	5358129	U	5	Bristol
177	00CMV-087a	17u	455880	5365837	L	1	Bristol
178	00CMV-100a	17u	458636	5357792	U	8	Bristol
179	00CMV-101a	17u	458699	5357517	U	6	Bristol
180	00CMV-106a	17u	459211	5364200	L	8	Bristol
181	00CMV-109a	17u	459443	5364601	U	2	Bristol
182	00CMV-114a	17u	458692	5357235	U	6	Bristol
183	00CMV-118a	17u	457774	5357986	T	8	Bristol
184	00CMV-124a	17u	458983	5361477	L	1	Bristol
185	00CMV-125aa	17u	459225	5359023	L	2	Bristol
186	00CMV-125ab	17u	459225	5359023	L	7	Bristol
187	00CMV-252a	17u	465331	5357559	L	2	Bristol
188	00CMV-259a	17u	455983	5358569	L	1	Bristol
189	00CMV-260a	17u	457006	5358857	L	2	Bristol

Map No.	Sample No.	zone	easting	northing	grade	rock type	township
190	00CMV-267b	17u	459894	5358092	L	1	Bristol
191	00CMV-267c	17u	459894	5358092	L	2	Bristol
192	00CMV-286a	17u	459263	5358619	L	2	Bristol
193	00CMV-298a	17u	459283	5357203	L	6	Bristol
194	00CMV-300a	17u	458926	5357127	L	2	Bristol
195	00CMV-429a	17u	457791	5365863	H	2	Bristol
196	00CMV-431c	17u	457442	5357802	L	6	Bristol
197	00CMV-507a	17u	465124	5362877	H	2	Bristol
198	00CMV-519a	17u	464374	5362327	L	2	Bristol
199	00CMV-601a	17u	464530	5361973	U	2	Bristol
200	00CMV-602a	17u	464821	5361845	L	2	Bristol
201	00CMV-602b	17u	464821	5361845	L	2	Bristol
202	00CMV-638a	17u	464721	5361917	L	2	Bristol
203	00CMV-638b	17u	464721	5361917	L	2	Bristol
204	00CMV-639a	17u	464627	5361972	L	2	Bristol
205	00CMV-639b	17u	464627	5361972	L	2	Bristol
206	00CMV-639c	17u	464627	5361972	L	2	Bristol
207	00CMV-639d	17u	464627	5361972	L	2	Bristol
208	00CMV-202b	17u	474783	5361920	L	2	Ogden
209	00CMV-206e2	17u	474154	5362193	L	5	Ogden
210	00CMV-206g	17u	474154	5362193	L	2	Ogden
211	00CMV-212a	17u	475061	5360027	H	3	Ogden
212	00CMV-218a2	17u	472376	5362165	L	3	Ogden
213	00CMV-218d	17u	472376	5362165	U	2	Ogden
214	00CMV-219b	17u	472300	5361818	L	2	Ogden
215	00CMV-220a1	17u	472841	5361900	L	2	Ogden
216	00CMV-220a2	17u	472841	5361900	L	2	Ogden
217	00CMV-222a	17u	472199	5361259	H	2	Ogden
218	00CMV-223a1	17u	472041	5361105	L	3	Ogden
219	00CMV-224a	17u	472224	5361177	L	1	Ogden
220	00CMV-232a	17u	471210	5365002	L	2	Ogden
221	00CMV-234a	17u	469536	5359826	L	6	Ogden
222	00CMV-241a	17u	471950	5364233	L	2	Ogden
223	00CMV-241b	17u	471950	5364233	T	2	Ogden
224	00CMV-243a	17u	474921	5363502	H	3	Ogden
225	00CMV-244a	17u	476164	5358722	L	7	Deloro
226	00CMV-245a	17u	476032	5358792	L	6	Deloro
227	00CMV-247a	17u	475290	5366575	L	2	Ogden
228	00CMV-250a	17u	475173	5363613	H	6	Ogden
229	00CMV-263a	17u	466586	5361918	L	3	Ogden
230	00CMV-274b1	17u	471427	5362716	L	2	Ogden
231	00CMV-302b	17u	474750	5363525	L	1	Ogden
232	00CMV-305a	17u	473823	5363324	L	6	Ogden
233	00CMV-401a	17u	475082	5359242	T	2	Ogden
234	00CMV-403a	17u	475439	5359266	T	1	Deloro
235	00CMV-701a	17u	473688	5362197	L	3	Ogden
236	00CMV-702b	17u	473783	5362249	L	2	Ogden
237	00CMV-705a	17u	471537	5362548	L	3	Ogden

Map No.	Sample No.	zone	easting	northing	grade	rock type	township
238	00CMV-706c	17u	471637	5362576	L	3	Ogden
239	00CMV-706d	17u	471637	5362576	L	7	Ogden
240	00CMV-708a	17u	471814	5362708	L	2	Ogden
241	00CMV-709a	17u	471714	5362482	L	2	Ogden
242	00CMV-709b	17u	471714	5362482	L	2	Ogden
243	00CMV-807g	17u	466946	5363321	L	1	Ogden
244	00CMV-809b	17u	467273	5362068	L	2	Ogden
245	00CMV-278a	17u	476750	5359771	L	3	Deloro
246	BH87-247	17u	484664	5366785	L	2	Tisdale
247	DP88-035	17u	481792	5367767	T	3	Tisdale
248	DP88-039	17u	482295	5367200	L	1	Tisdale
249	DP88-043	17u	482926	5368182	L	1	Tisdale
250	DP88-068	17u	479370	5370420	L	2	Tisdale
251	DP88-070	17u	481524	5367818	L	2	Tisdale
252	DP88-101	17u	481524	5367818	L	2	Tisdale
253	DP88-106	17u	482659	5369196	L	5	Tisdale
254	DP88-108	17u	479370	5370420	L	2	Tisdale
255	DP88-110	17u	482904	5370976	L	2	Tisdale
256	KK87-175	17u	484201	5367343	L	7	Tisdale
257	KK87-177	17u	484660	5369022	L	2	Tisdale
258	KK88-010	17u	475759	5373557	L	9	Tisdale
259	KK88-033	17u	477829	5370446	L	1	Tisdale
260	KK88-036	17u	479648	5367745	L	2	Tisdale
261	KK88-136	17u	479010	5369010	T	2	Tisdale
262	KK88-151	17u	480126	5368847	L	2	Tisdale
263	KK88-204	17u	480036	5369633	L	6	Tisdale
264	KK88-205	17u	476890	5369307	L	2	Tisdale
265	KK88-218	17u	481732	5368266	T	2	Tisdale
266	KK88-223	17u	482444	5368800	T	2	Tisdale
267	BH87-009	17u	486221	5368511	L	3	Whitney
268	BH87-047	17u	486352	5367219	L	2	Whitney
269	BH87-072	17u	485948	5366633	L	2	Whitney
270	BH87-103	17u	484961	5367311	L	9	Whitney
271	BH87-116	17u	486834	5367486	L	2	Whitney
272	BH87-157	17u	487667	5367444	L	2	Whitney
273	BH87-169	17u	487802	5367503	L	3	Whitney
274	BH87-284a	17u	486258	5368074	L	2	Whitney
275	BH87-284b	17u	486258	5368074	L	2	Whitney
276	DP87-003a	17u	485614	5367509	U	5	Whitney
277	DP87-005	17u	485635	5367846	U	5	Whitney
278	DP87-006a	17u	485625	5367948	L	4	Whitney
279	DP87-006b	17u	485625	5367948	L	4	Whitney
280	DP87-008	17u	485674	5368154	L	4	Whitney
281	DP87-010	17u	485990	5368183	L	2	Whitney
282	DP87-019	17u	485779	5368333	L	2	Whitney
283	DP87-020	17u	485799	5368373	L	3	Whitney
284	DP87-021	17u	485827	5368216	L	3	Whitney
285	DP87-022	17u	485803	5368522	L	2	Whitney

Map No.	Sample No.	zone	easting	northing	grade	rock type	township
286	DP87-024	17u	485799	5368631	L	4	Whitney
287	DP87-025	17u	485838	5368761	L	2	Whitney
288	DP87-026	17u	485247	5368891	U	2	Whitney
289	DP87-029	17u	485970	5367776	L	2	Whitney
290	DP87-031	17u	486048	5368292	L	2	Whitney
291	DP87-036	17u	486029	5368451	L	3	Whitney
292	DP87-037	17u	485972	5368571	L	4	Whitney
293	DP87-041	17u	486393	5368094	L	2	Whitney
294	DP87-042	17u	486422	5368162	L	7	Whitney
295	DP87-042b	17u	486422	5368162	L	4	Whitney
296	DP87-043	17u	486395	5368918	L	9	Whitney
297	DP87-051	17u	487279	5369572	H	2	Whitney
298	DP87-053	17u	487355	5369095	L	1	Whitney
299	DP87-054a-1	17u	487423	5369602	L	4	Whitney
300	DP87-054a-2	17u	487423	5369602	L	4	Whitney
301	DP87-055	17u	488931	5370433	L	2	Whitney
302	DP87-057	17u	489142	5370543	L	8	Whitney
303	DP87-063	17u	491024	5371901	H	2	Whitney
304	DP87-065	17u	494563	5373383	L	2	Whitney
305	DP88-001	17u	487961	5369790	L	2	Whitney
306	DP88-003	17u	487884	5369631	U	2	Whitney
307	DP88-011	17u	487578	5370267	L	2	Whitney
308	DP88-016	17u	487442	5369662	L	4	Whitney
309	DP88-017	17u	487606	5369680	L	4	Whitney
310	DP88-018	17u	492847	5375039	L	2	Whitney
311	DP88-021	17u	492917	5375120	L	1	Whitney
312	DP88-022	17u	492917	5375120	L	1	Whitney
313	DP88-023	17u	492917	5375120	T	3	Whitney
314	DP88-024	17U	492947	5374917	L	2	Whitney
315	DP88-100	17u	492947	5374917	L	2	Whitney
316	KK87-001	17u	487812	5367682	L	2	Whitney
317	KK87-016	17u	486882	5367808	H	2	Whitney
318	KK87-018	17u	486892	5368002	U	5	Whitney
319	KK87-019	17u	486854	5368171	L	7	Whitney
320	KK87-031	17u	487227	5367734	L	2	Whitney
321	KK87-040	17u	487381	5367782	T	1	Whitney
322	KK87-040a?	17u	487381	5367782	L	7	Whitney
323	KK87-041-1	17u	487373	5367902	L	3	Whitney
324	KK87-041-2	17u	487373	5367902	L	3	Whitney
325	KK87-044	17u	487602	5367723	L	2	Whitney
326	KK87-057	17u	487803	5367831	L	2	Whitney
327	KK87-072	17u	487786	5368716	L	3	Whitney
328	KK87-077	17u	488015	5368020	L	7	Whitney
329	KK87-078	17u	488043	5367702	L	7	Whitney
330	KK87-082a	17u	487457	5367862	L	7	Whitney
331	KK87-084	17u	487486	5368100	L	7	Whitney
332	KK87-089	17u	488147	5367433	U	5	Whitney
333	KK87-090	17u	488685	5367671	L	6	Whitney

Map No.	Sample No.	zone	easting	northing	grade	rock type	township
334	KK87-092	17u	488581	5367870	L	7	Whitney
335	KK87-093	17u	488629	5367949	L	6	Whitney
336	KK87-119	17u	489068	5366944	H	6	Whitney
337	KK87-122	17u	488924	5367053	L	2	Whitney
338	KK87-159	17u	491075	5372250	T	2	Whitney
339	KK87-178c	17u	484660	5369022	L	3	Whitney
340	KK87-178e	17u	484660	5369022	L	3	Whitney
341	KK88-021	17u	487158	5370785	L	7	Whitney

Metric Conversion Table

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
		LENGTH			
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
		AREA			
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
		VOLUME			
1 cm^3	0.061 023	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.307 951	cubic yards	1 cubic yard	0.764 554 86	m^3
		CAPACITY			
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
		MASS			
1 g	0.035 273 962	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 747	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 622 6	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311 3	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 90**	t
		CONCENTRATION			
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	Multiplied by	
1 ounce (troy) per ton (short)	31.103 477	grams per ton (short)
1 gram per ton (short)	0.032 151	ounces (troy) per ton (short)
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.

MAPS

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CARTES

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